MGC3130 Aurea

Graphical User Interface User's Guide

© 2013 Microchip Technology Inc.

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE**.** Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

Trademarks

The Microchip name and logo, the Microchip logo, dsPIC, FlashFlex, KEELOQ, KEELOQ logo, MPLAB, PIC, PICmicro, PICSTART, PIC^{32} logo, rfPIC, SST, SST Logo, SuperFlash and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

FilterLab, Hampshire, HI-TECH C, Linear Active Thermistor, MTP, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

Analog-for-the-Digital Age, Application Maestro, BodyCom, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, HI-TIDE, In-Circuit Serial Programming, ICSP, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, mTouch, Omniscient Code Generation, PICC, PICC-18, PICDEM, PICDEM.net, PICkit, PICtail, REAL ICE, rfLAB, Select Mode, SQI, Serial Quad I/O, Total Endurance, TSHARC, UniWinDriver, WiperLock, ZENA and Z-Scale are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

GestIC and ULPP are registered trademarks of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2013, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

Printed on recycled paper.

ISBN: 9781620777022

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
═ ISO/TS 16949 ═

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

© 2013 Microchip Technology Inc.

Table of Contents

Chapter 1. Overview

1.1 Introduction 10
1.1.1 Install Aurea 10
1.1.2 Running Aurea 10
1.2 Aurea Graphical User Interface 11
1.2.1 Aurea Tabs 11
1.2.2 Real-Time Control 12
1.2.3 Control Bar 13
1.2.4 Status Bar 14

Chapter 2. Aurea Tabs

2.1 Colibri Suite 15
2.1.1 Colibri Suite Tab 15
2.1.1.1 XY and XYZ Position-Tracking Plots 16
2.1.1.2 Signal Level 17
2.1.1.3 History Logging 17
2.1.1.4 Gesture Indication 17
2.1.2 Colibri Suite Real-Time Control 18
2.1.2.1 Gestures 18
2.1.2.2 Applications 21
2.1.2.3 Feature Control 22
2.2 Signals 23
2.2.1 Signals Visualization Tab 23
2.2.2 Signals Real-Time Control 24
2.2.2.1 Channels 24
2.2.2.2 Levels 24
2.2.2.3 Autocalibration Check-Box 24
2.2.2.4 Approach Detection/Power-Saving Check-Box 25
2.2.2.5 Autozoom Check-Box 25
2.2.2.6 Signal Drop-down List 25
2.2.2.7 Automatic Frequency Hopping List 25
2.2.2.8 Force Calibration Button 25
2.3 Setup 26
2.3.1 Flash Library File 26
2.3.2 Colibri Parameterization 28
2.3.2.1 Start New Parameterization 28
2.3.2.2 Load from File 29
2.3.2.3 Parameterization Progress State 30
2.3.2.4 Parameterization Navigation 30
2.3.2.5 Parameterization Options 31
2.3.2.6 Analog Front End (AFE) 32
2.3.2.7 System Start-up 34
2.3.2.8 Position Tracking 36

2.3.2.9 HMM Gesture Recognition 46
2.3.2.10 Approach Detection 50
2.3.2.11 Touch Detection 51
2.3.2.12 AirWheel 52
2.3.2.13 Noise Power 54
2.3.2.14 Gesture Port 55
2.3.2.15 Save Parameterization 57
2.3.3 Electrode Capacitance Measurement 58
2.3.3.1 Step 1: Initial Measurement (VRx) 59
2.3.3.2 Step 2: Measurement with Auxiliary Capacitors (V'Rx) 60

Chapter 3. Advanced Aurea Features

3.1 Logging Sensor Data 62
3.1.1 Record a Log File 62
3.1.2 Log File Content and Format 63
3.2 Sensitivity Profile Acquisition 65
3.2.1 Sensor Calibration 65
3.2.2 Measurement 65
3.3 Sniffing Mode 66
3.3.1 Saleae 67
3.3.2 Install Saleae 67
3.3.3 Saleae Hardware Connection 67
3.3.4 Running Aurea with Saleae 67

Appendix A. Glossary

Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXA", where "XXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MGC3130 Aurea Graphical Interface. Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- Warranty Registration
- Recommended Reading
- The Microchip Web Site
- Development Systems Customer Change Notification Service
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes the installation and use of the MGC3130 Aurea Graphical Interface. Microchip's Aurea is a Windows® based graphical user interface that can be used to demonstrate, evaluate and configure Microchip's MGC3130 3D Tracking and Gesture Controller. The document is organized as follows:

- **Chapter 1. "Overview"**
- **Chapter 2. "Aurea Tabs"**
- **Chapter 3. "Advanced Aurea Features"**
- **Appendix A. "Glossary"**

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

© 2013 Microchip Technology Inc.

WARRANTY REGISTRATION

Please complete the enclosed Warranty Registration Card and mail it promptly. Sending in the Warranty Registration Card entitles users to receive new product updates. Interim software releases are available at the Microchip web site.

RECOMMENDED READING

This user's guide describes how to use the MGC3130 Aurea Graphical User Interface. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources.

- *"MGC3130 Single-Zone 3D Gesture Controller Data Sheet"* (DS40001667) – Consult this document for information regarding the MGC3130 3D Tracking and Gesture Controller.
- *"MGC3130 GestIC® Design Guide"* (DS40001716) – This document describes the MGC3130 system characteristic parameters and the design process. It enables the user to generate a good electrode design and to parameterize the full GestIC® system.
- *"MGC3130 GestIC® Library Interface Description User's Guide"* (DS40001718) – This document is the interface description of the MGC3130's GestIC Library. It outlines the function of the Library's message interface, and contains the complete message reference to control and operate the MGC3130 system.
- *"MGC3130 Sabrewing Single Zone Evaluation Kit"* (DS41685) – This document describes the Sabrewing Evaluation Kit demonstrating Microchip's GestIC technology.
- *"MGC3130 Hillstar Development Kit User's Guide"* (DS40001721) – This document describes the Hillstar Development Kit supporting an easy integration of Microchip's MGC3130 3D Tracking and Gesture Controller into the user's applications.

THE MICROCHIP WEB SITE

Microchip provides online support via our web site at www.microchip.com. This web site is used as a means to make files and information easily available to customers.

Information about GestIC technology and MGC3130 can be directly accessed via www.microchip.com/gestic.

DEVELOPMENT SYSTEMS CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip web site at www.microchip.com, click on Customer Change Notification and follow the registration instructions.

The Development Systems product group categories are:

- **Compilers** – The latest information on Microchip C compilers, assemblers, linkers and other language tools. These include all MPLAB® C compilers; all MPLAB assemblers (including MPASM™ assembler); all MPLAB linkers (including MPLINK™ object linker); and all MPLAB librarians (including MPLIB™ object librarian).
- **Emulators** – The latest information on Microchip in-circuit emulators.This includes the MPLAB REAL ICE and MPLAB ICE 2000 in-circuit emulators.
- **In-Circuit Debuggers** – The latest information on the Microchip in-circuit debuggers. This includes MPLAB ICD 3 in-circuit debuggers and PICkit™ 3 debug express.
- **MPLAB IDE** – The latest information on Microchip MPLAB IDE, the Windows Integrated Development Environment for development systems tools. This list is focused on the MPLAB IDE, MPLAB IDE Project Manager, MPLAB Editor and MPLAB SIM simulator, as well as general editing and debugging features.
- **Programmers** – The latest information on Microchip programmers. These include production programmers such as MPLAB® REAL ICE™ in-circuit emulator, MPLAB ICD 3 in-circuit debugger and MPLAB PM3 device programmers. Also included are nonproduction development programmers such as PICSTART® Plus and PICkit 2 and 3.

© 2013 Microchip Technology Inc.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers.

Technical support is available through the web site at:

http://www.microchip.com/support.

SOFTWARE LICENSE INFORMATION

Copyright (C) 2013 Microchip Technology Inc. and its subsidiaries (“Microchip”). All rights reserved.

You are permitted to use the Aurea software, MGC3130 Software Development Kit and other accompanying software with Microchip products. Refer to the license agreement accompanying this software, if any, for additional info regarding your rights and obligations.

SOFTWARE AND DOCUMENTATION ARE PROVIDED “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY, TITLE, NON-INFRINGEMENT AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL MICROCHIP, SMSC, OR ITS LICENSORS BE LIABLE OR OBLIGATED UNDER CONTRACT, NEGLIGENCE, STRICT LIABILITY, CONTRIBUTION, BREACH OF WARRANTY, OR OTHER LEGAL EQUITABLE THEORY FOR ANY DIRECT OR INDIRECT DAMAGES OR EXPENSES INCLUDING BUT NOT LIMITED TO ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, OR OTHER SIMILAR COSTS.

DOCUMENT REVISION HISTORY

Revision A (February, 2013)

- Initial release of the document.

Revision B (August, 2013)

- Updated to support Colibri Parameterization (Updated chapters 1, 2 and 3).
- Aligned with Aurea GUI Version 0.4.20 or later.

Revision C (November, 2013)

- Updated chapters 1, 2 and 3; Updated Appendix A.

Chapter 1. Overview

1.1 INTRODUCTION

The Aurea evaluation software demonstrates Microchip's GestIC technology and its features and applications. Aurea provides visualization of MGC3130 generated data and access to GestIC Library controls and configuration parameters.

That contains the following:

- Visualization of hand position and user gestures
- Visualization of sensor data
- Control of sensor features
- MGC3130 GestIC Library update
- Analog Front End parameterization
- Colibri Signal Processing parameterization
- Electrode capacitance measurement
- Logging of sensor values and storage in a log file
- Sniffing of MGC3130 I²C™ traffic via Saleae Logic Analyzer

1.1.1 Install Aurea

To install Aurea on your system:

- Download and install the MGC3130 software package.

1.1.2 Running Aurea

Aurea requires Windows® XP, Windows® 7 or Windows® 8 operating system, a USB port and a minimum screen resolution of 1024x768.

To start Aurea:

1. Connect the GestIC device to your PC via USB port (for information on the GestIC devices supported by your Aurea version, refer to the *Aurea Release Notes*).
2. To start Aurea, double click on the `$\Install_Directory\Microchip\MGC3130\02_Aurea\Aurea.exe` installed on your drive after installation or select *Start>Programs>Aurea>Aurea*. A screen will display the Aurea GUI.
3. Aurea detects the GestIC device automatically and is ready for use.

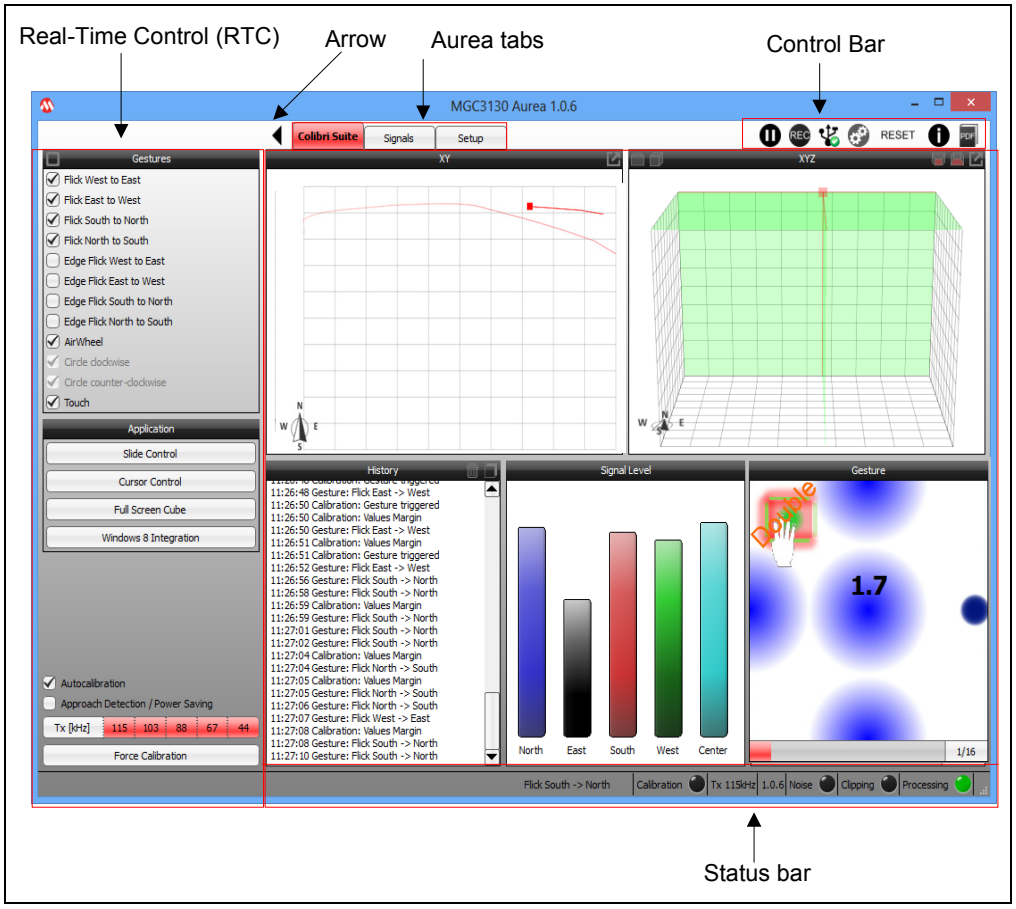
Note: If you encounter problems while connecting your GestIC® device with Aurea, make sure the appropriate USB drivers are installed on your PC. For troubleshooting, refer to the user's manual of your GestIC® device.

1.2 AUREA GRAPHICAL USER INTERFACE

Aurea's graphical user interface is divided into four sections (see Figure 1-1):

- Aurea tabs
- Real-Time Control
- Control bar
- Status bar

FIGURE 1-1: AUREA GRAPHICAL USER INTERFACE



1.2.1 Aurea Tabs

The visualization of the DSP output, sensor signals and the setup of the Colibri Suite are shown in three individual Aurea tabs, which can be selected from the upper part of the window.

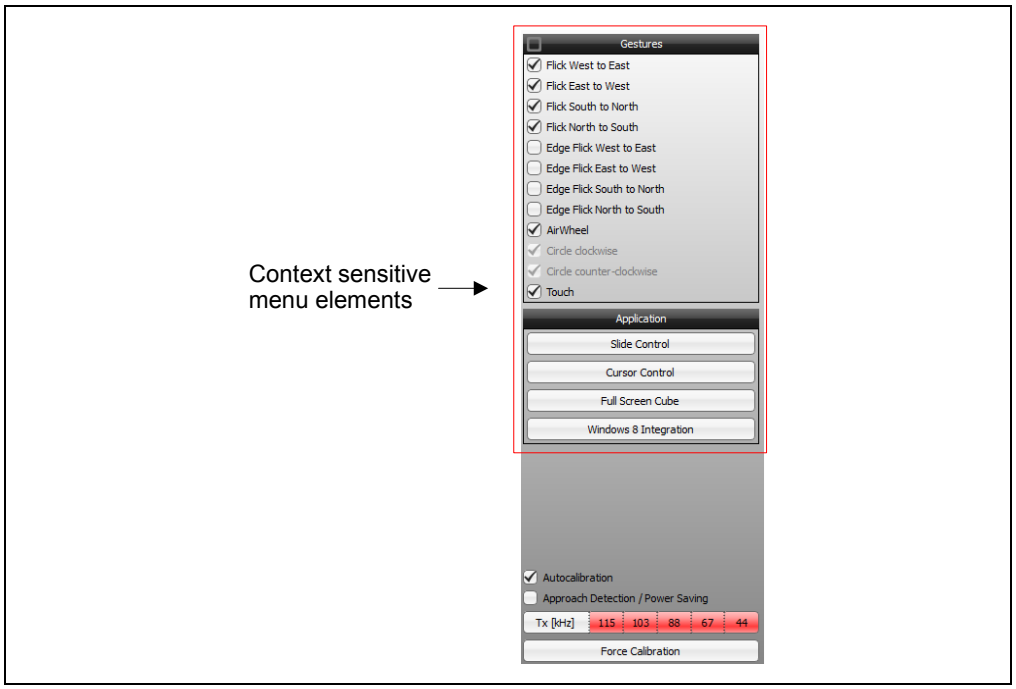
- **Colibri Suite** shows the output of digital signal processing;
- **Signals** plots various sensor signals over time;
- **Setup** allows GestIC Library update, Analog Front End adjustments, Colibri parameterization and electrode capacitances measurements.

1.2.2 Real-Time Control

Real-Time Control (RTC) can be opened and closed by clicking the arrow in the upper left corner of the Aurea window. RTC contains context-sensitive settings, which depend on the active Aurea tab. An example is shown in Figure 1-2.

Depending on the active Aurea tab, context-sensitive settings can be accessed in the upper part of Real-Time Control.These settings are explained in detail in **Chapter 2. "Aurea Tabs"**, when the individual Aurea tabs are described.

FIGURE 1-2: AUREA REAL-TIME CONTROL



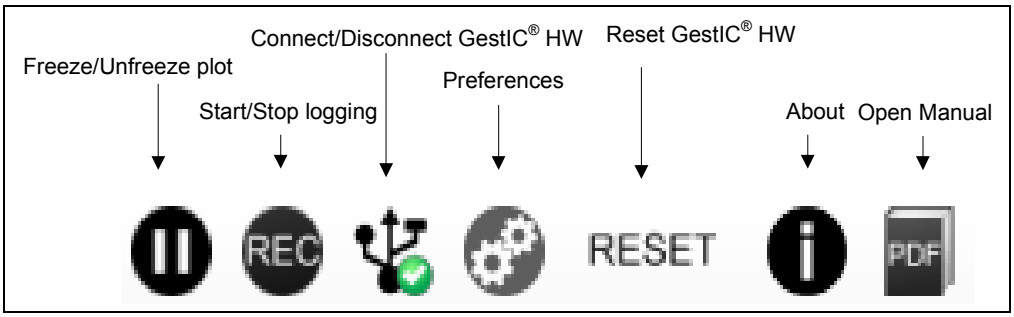
© 2013 Microchip Technology Inc.

1.2.3 Control Bar

The control bar elements are valid for all Aurea tabs and are always visible across all tabs and can be accessed in the upper right corner within Aurea. These static control elements are (see Figure 1-3):

- **Freeze/Unfreeze Plot**: Press this button to freeze the Visualization window. Press it again to continue plotting.
- **Start Log/Stop Log**: Records and saves sensor data into a log file. Refer to **Chapter 3. "Advanced Aurea Features"** for additional details.
- **Connect/Disconnect**: Toggles connect and disconnect of the USB connection between the PC and the attached hardware which will be used to read the data output from MGC3130 I^2C protocol. This hardware can be GestIC Bridge or Saleae USB Logic Analyzer.
- **Preferences**: Configures the hardware which will be used to read the data output from MGC3130 I^2C protocol. This hardware can be GestIC Bridge or Saleae USB Logic Analyzer. Refer to **Section 3.3 "Sniffing Mode"** for additional details.
- **Reset**: Initiates a reset of the MGC3130.
- **About Aurea**
- **Open Manual**

FIGURE 1-3: AUREA CONTROL BAR



1.2.4 Status Bar

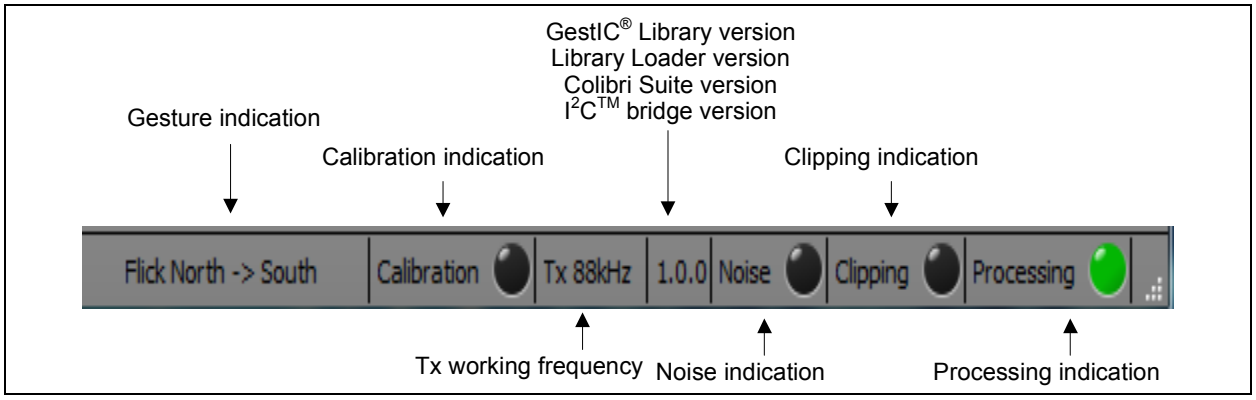
The static Status Bar is located at the bottom of the Aurea window and it provides information about the recent status of the MGC3130 system (see to Figure 1-4).

The following information displays from left to right:

- Gesture indication shows the latest recognized gesture (only when the **Colibri Suite** tab is active)
- Calibration indication flashes when a sensor calibration is issued
- Tx working frequency currently used by the MGC3130
- GestIC Library version read from the MGC3130 after start-up and Reset. When moving the cursor on it, other versions are displayed:
  - Library Loader version read MGC3130 after Reset
  - Colibri Suite version read from the MGC3130 after start-up and Reset
  - I^2C Bridge version read from GestIC device after start-up
- Noise indication flashes when high noise is detected
- Clipping indication flashes when signal clipping is detected
- Processing indication lights up when the MGC3130 is in Processing mode and turns off when in power-saving Sleep mode

Note:	Calibration, noise and clipping indication are deactivated in the Colibri Parameterization of the AFE.

FIGURE 1-4: AUREA STATUS BAR



© 2013 Microchip Technology Inc.

Chapter 2. Aurea Tabs

This chapter describes the individual tabs of Aurea and the respective context-sensitive settings within Real-Time Control.

2.1 COLIBRI SUITE

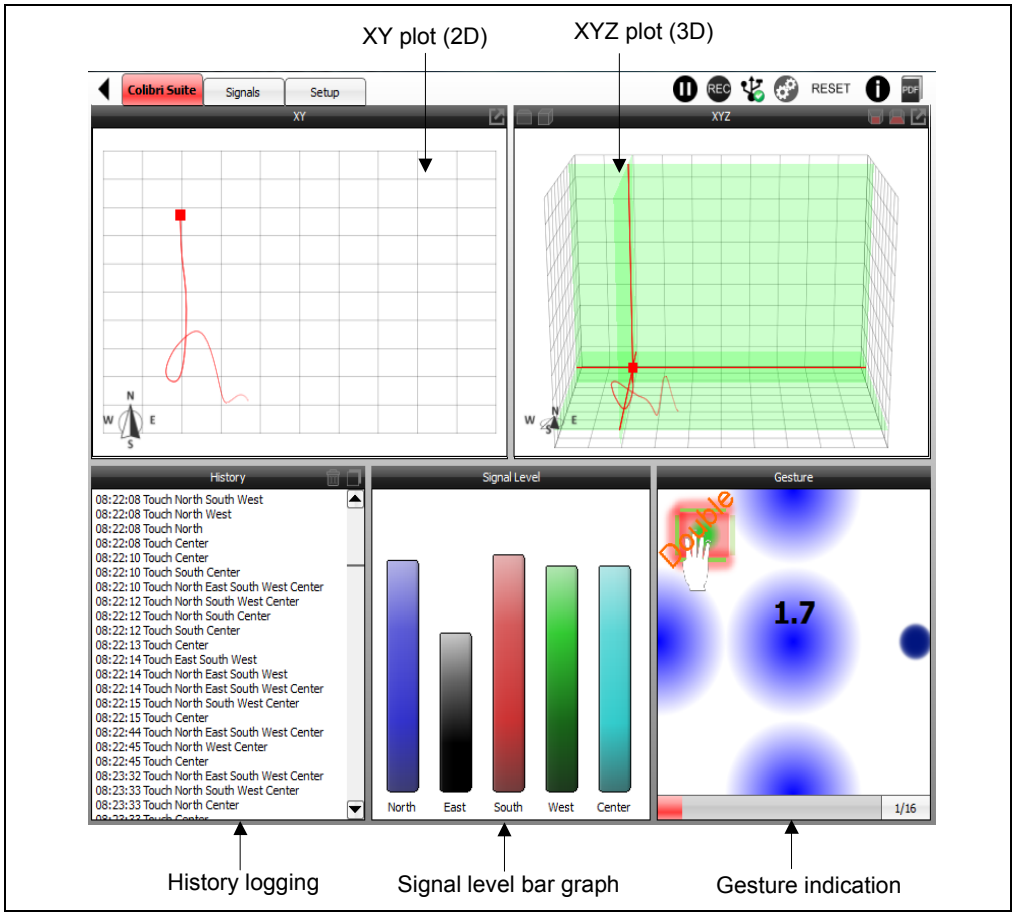
2.1.1 Colibri Suite Tab

The **Colibri Suite** tab displays the MGC3130 3D gesture recognition and position tracking features, and is divided into five sub-windows (Figure 2-1):

- XY position tracking plot (2D)
- XYZ position tracking plot (3D)
- Signal level bar graph
- History Logging window
- Gesture Indication window

Note: When the Approach Detection/Power-Saving feature is enabled, the MGC3130 controller is set to Sleep when no hand is present and the processing indication is turned off. In addition, the signal stream stops and the tab background turns gray. When a hand approaches the sensing area, the system will wake-up.

FIGURE 2-1: COLIBRI SUITE TAB

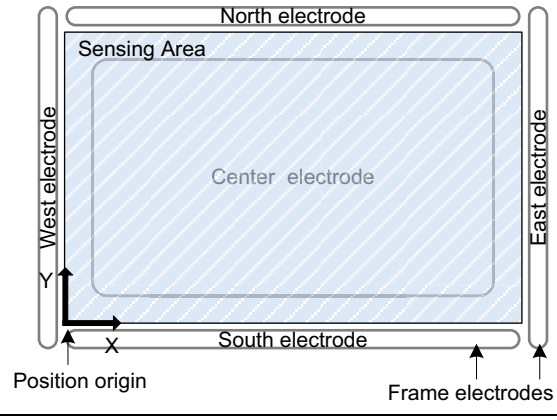


2.1.1.1 XY AND XYZ POSITION-TRACKING PLOTS

The red cursor in the XY and XYZ plots appears as a projection of the user's hand position within the sensing space. The cursor follows the hand in real time and is followed by a red tail to indicate the position history.

Figure 2-2 shows a typical set of frame electrodes and the respective sensitive area in between. The origin of the coordinate system is located in the lower left corner.

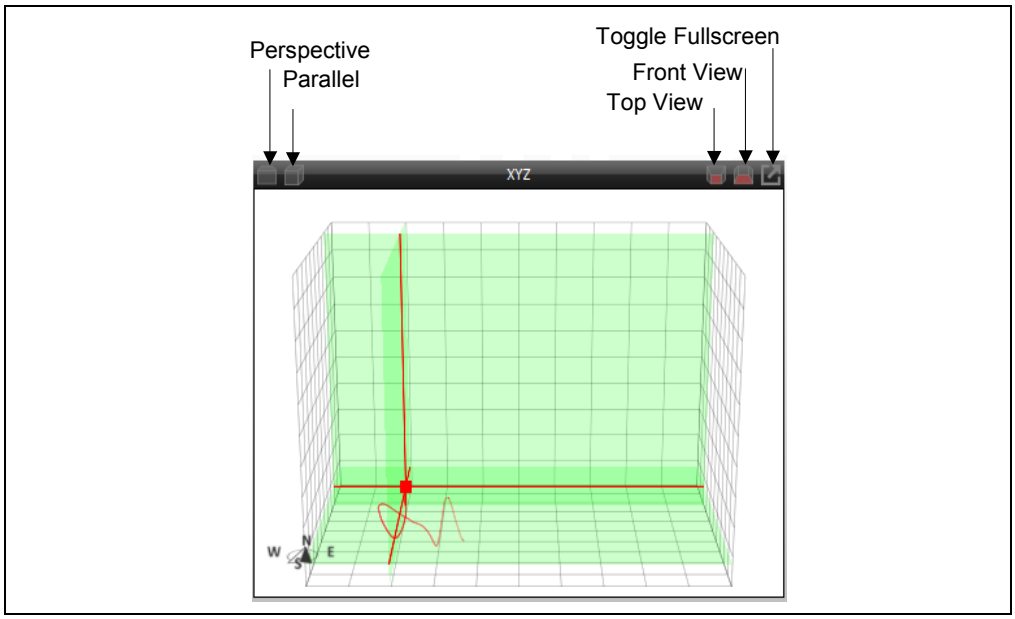
FIGURE 2-2: SENSING AREA



© 2013 Microchip Technology Inc.

The XY plot represents the XY position of the user's hand inside the sensing space. If the user's hand is at the West side of the sensing space, the cursor also appears on the West side within the position tracking plot. Moving the hand to the East causes the cursor to follow. The XYZ plot adds the third dimension. The user can rotate the coordinate system in Aurea by using a computer mouse or by selecting one of four presettings located at the top of the window. The available presettings are Perspective, Parallel, Top View and Front View, as shown in Figure 2-3.

FIGURE 2-3: XYZ PLOT



2.1.1.2 SIGNAL LEVEL

The sensor signals are displayed in the Signal Level bar graphic. To distinguish between the individual electrodes, they are color-coded according to their cardinal directions (North, East, South, West, Center). Approaching one electrode causes the respective signal to increase.

2.1.1.3 HISTORY LOGGING

The History Logging window lists important events like calibrations and the classification of gestures. A complete log of messages and events is contained in the log file. Refer to **Chapter 3. "Advanced Aurea Features"** for additional details.

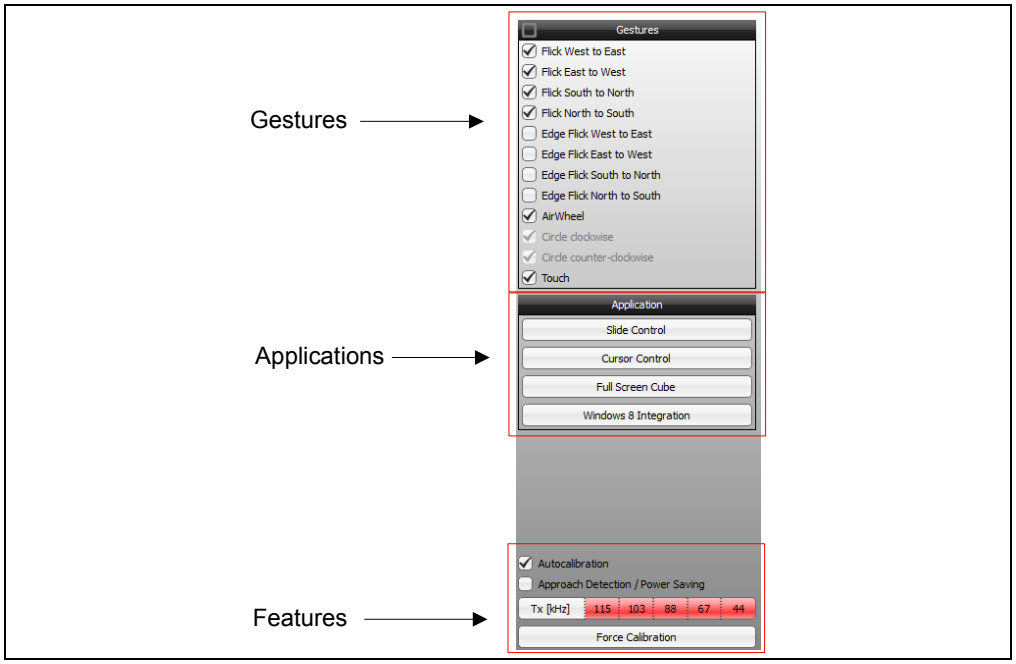
2.1.1.4 GESTURE INDICATION

The classification of gestures is displayed in the Gesture Indication window. Refer to **Section 2.1.2 "Colibri Suite Real-Time Control "** for guidance on performing gestures and controlling the available gesture set.

2.1.2 Colibri Suite Real-Time Control

The Real-Time Control of the **Colibri Suite** tab allows the control of gestures in the Gestures section, the launch of demo applications in the Applications section and the control of selected features applied to the MGC3130 (see Figure 2-4).

FIGURE 2-4: COLIBRI SUITE REAL-TIME CONTROL



2.1.2.1 GESTURES

The Colibri Suite uses Hidden Markov Models (HMM) providing user-independent gesture recognition. The gesture recognition starts when a hand enters the sensing space or when a movement is detected after a resting period. A gesture ends when the hand leaves or rests inside the sensing space. Gestures can have various sizes and can be performed at various speeds, within limits. For instance, gesture recognition does not trigger when the movement of a gesture is very slow or particularly fast.

© 2013 Microchip Technology Inc.

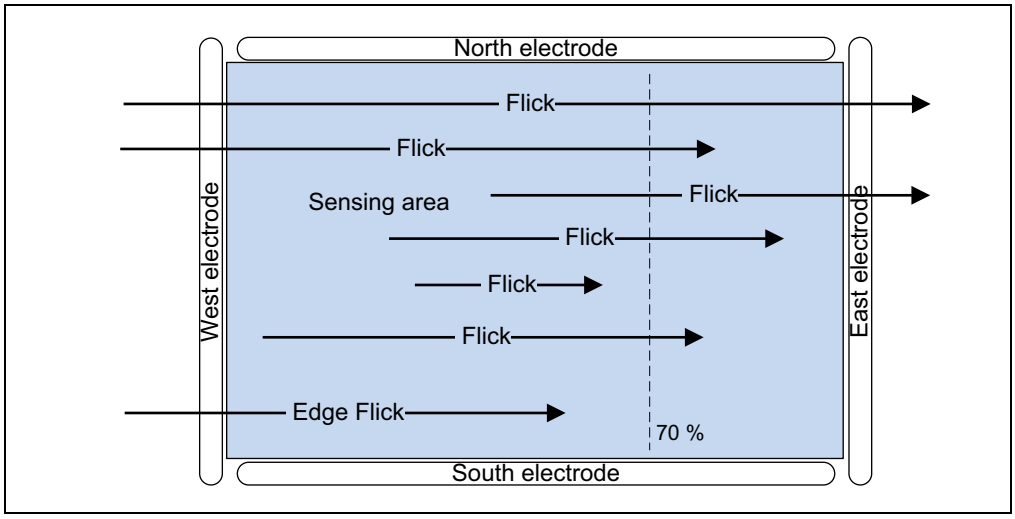
2.1.2.1.1 Flick Gestures

A flick gesture is defined as a linear hand or finger movement in a specified direction. Flick gestures can start and end inside and outside the sensing space.

The Colibri Suite supports flick gestures in four directions and can further distinguish edge flicks. Edge flicks are performed at the edge of the sensing space. They always start outside the sensing space and cover less than 70% of it.

The implementation of flick recognition is illustrated in Figure 2-5 on the example of flicks from West to East.

FIGURE 2-5: EXAMPLES FOR FLICK RECOGNITION



Colibri RTC supports the flick gestures listed in Table 2-1. The gestures can be individually enabled and disabled by checking and unchecking the respective check-boxes.

TABLE 2-1: FLICK GESTURES

Symbol	Gesture	Symbol	Gesture
→	Flick West to East	→	Edge Flick West to East
←	Flick East to West	←	Edge Flick East to West
↑	Flick South to North	↑	Edge Flick South to North
↓	Flick North to South	↓	Edge Flick North to South

2.1.2.1.2 Circular Gestures

A circular gesture is a round-shaped hand movement defined by direction (clockwise/counterclockwise) without any specific start position of the user's hand.
Two types of circular gestures are distinguished by GestIC:

a) Discrete Circles: Discrete Circles are recognized after performing a hand movement inside the sensing space. The recognition result (direction: clockwise/counterclockwise) is provided after the hand movement stops or the hand exits the detection area. Discrete Circles are typically used as dedicated application control commands.
b) AirWheel: An AirWheel is the recognition of continuously performed circles inside the sensing space and provides information about the rotational movement in real time. It starts after at least one quadrant of a circle is recognized and provides continuously counter information which increments/decrements according to the movement's direction (clockwise/counterclockwise). The counter step size can be adjusted for convenient usage in various applications like volume control, sensitivity adjustment or light dimming.

Discrete Circles and AirWheel are exclusive.

Colibri RTC supports circular gestures as listed in Table 2-2. The gestures can be individually enabled and disabled by checking and unchecking the respective check-boxes.

TABLE 2-2: CIRCULAR GESTURES

Type	Symbol	Gesture
Discrete Circles		Circle clockwise
		Circle counter-clockwise
AirWheel		AirWheel

2.1.2.1.3 Sensor Touch Gestures

A Sensor Touch is a multi zone gesture that reports up to five concurrently-performed touches on the system's electrodes.
Sensor Touch provides information about Touch and Tapping:

a) Touch: The Sensor Touch indicates the event during which a GestIC electrode is touched. This allows for example the distinction between short and long touches.
b) Tap and Double Tap: The Tap and Double Tap signalize short taps and double taps on each system electrode. The Tap length and Double Tap interval are adjustable.

Gesture Recognition Notes

Note 1: The gesture recognition software provides a garbage model to classify unintended gestures.

2: Individual gestures can be enabled or disabled within RTC. Reducing the gesture set will increase the recognition rate.

3: Discrete Circles and AirWheel gestures are exclusive. The activation of AirWheel will automatically deactivate the Discrete Circle gestures.

© 2013 Microchip Technology Inc.

2.1.2.2 APPLICATIONS

Four applications can be launched in RTC:

- **Slide Show**
- **Cursor Control**
- **Full Screen Cube**
- **Windows 8 Integration** (available only when Aurea is running on Windows 8)

2.1.2.2.1 Slide Show

Slide Show allows the user to control applications by using gestures. Three simple flick gestures are mapped to predefined keys emulating keystrokes (see Table 2-3).

TABLE 2-3: GESTURE SUPPORT IN SLIDE SHOW

Symbol	Gesture	Windows Key
	Flick South to North	F5
	Flick East to West	Right arrow
	Flick West to East	Left arrow
	AirWheel	Fast forward or backward

For example, control Microsoft PowerPoint® with gestures as follows:

1. Click **Slide Show** in the Applications section.
2. Open a Microsoft PowerPoint presentation of your choice.
3. Perform flick gesture from South to North to start presentation.
4. Perform flick gesture from East to West to go to next slide.
5. Perform flick gesture from West to East to go to previous slide.
6. Use the AirWheel for fast forward or backward.
7. Deactivate **Slide Show** within Aurea to quit.

2.1.2.2.2 Cursor Control

The **Cursor Control** application demonstrates the PC mouse cursor controlled by the MGC3130. Start the application and move the mouse cursor by sliding your hand over the sensing area of your GestIC device. Quit the application at any time by using the **Escape** key on your keyboard.

2.1.2.2.3 Full Screen Cube

The **Full Screen Cube** application demonstrates the Gesture Cube controlled by the MGC3130. Start the application and rotate the cube by moving your hand over the sensing area of your GestIC device. Quit the application at any time by using the **Escape** key on your keyboard.

2.1.2.2.4 Windows 8 Integration

Windows 8 allows the user to control Windows 8 features by using gestures. Three simple flick gestures are mapped to predefined keys emulating keystrokes (see Table 2-4).

TABLE 2-4: GESTURE SUPPORT IN WINDOWS 8 INTEGRATION

Symbol	Gesture	Windows Key
	Flick West to East	**Windows**
	Flick East to West	**Windows +C**
	Flick South to North	**Right Click**

1. Click **Windows 8 Integration** in the Applications section.
2. Perform flick gesture from West to East to switch between **Windows 8 Desktop** and **Start Screen**.
3. Perform flick gesture from East to West to open the **Windows 8 Charms Bar**.
4. Perform flick gesture from South to North to perform a **Right Click**.
5. Deactivate **Windows 8 Integration** within Aurea to quit.

2.1.2.3 FEATURE CONTROL

2.1.2.3.1 Autocalibration Check-Box

For the electrode system to continuously adapt to environmental changes, the GestIC Library includes an autocalibration functionality. The calibration events can be watched in the status bar (refer to **Section 1.2.4 "Status Bar "**) and the History Logging window of the **Colibri Aurea** tab. Uncheck the **Autocalibration** check-box to disable the Autocalibration feature.

Note 1: When **Autocalibration** is disabled, a system calibration can be started by the **Force Calibration** button.

Note 2: When **Autocalibration** is disabled, **Approach Detection** is also disabled.

2.1.2.3.2 Approach Detection/Power-Saving Check-Box

Approach Detection is disabled on Aurea start-up. Check the **Approach Detection/Power-Saving** check-box to enable the Wake-up on Approach feature.

2.1.2.3.3 Automatic Frequency Hopping List

Depending on the external noise conditions, the MGC3130 controller chooses the best working frequency automatically. The frequencies which are used by the AFA algorithm can be selected by checking the desired frequency box to enable it (red color). Press it again to exclude this frequency (gray color). This forces the system to continuously use only the selected frequencies. The following frequencies are available: 44 kHz, 67 kHz, 88 kHz, 103 kHz and 115 kHz.

2.1.2.3.4 Force Calibration Button

Press **Force Calibration** to calibrate the sensor manually. Make sure the sensor is not influenced by the user when executing a calibration. The idle system is properly calibrated when the *Signal Deviation* of all channels is at or near zero.

© 2013 Microchip Technology Inc.

2.2 SIGNALS

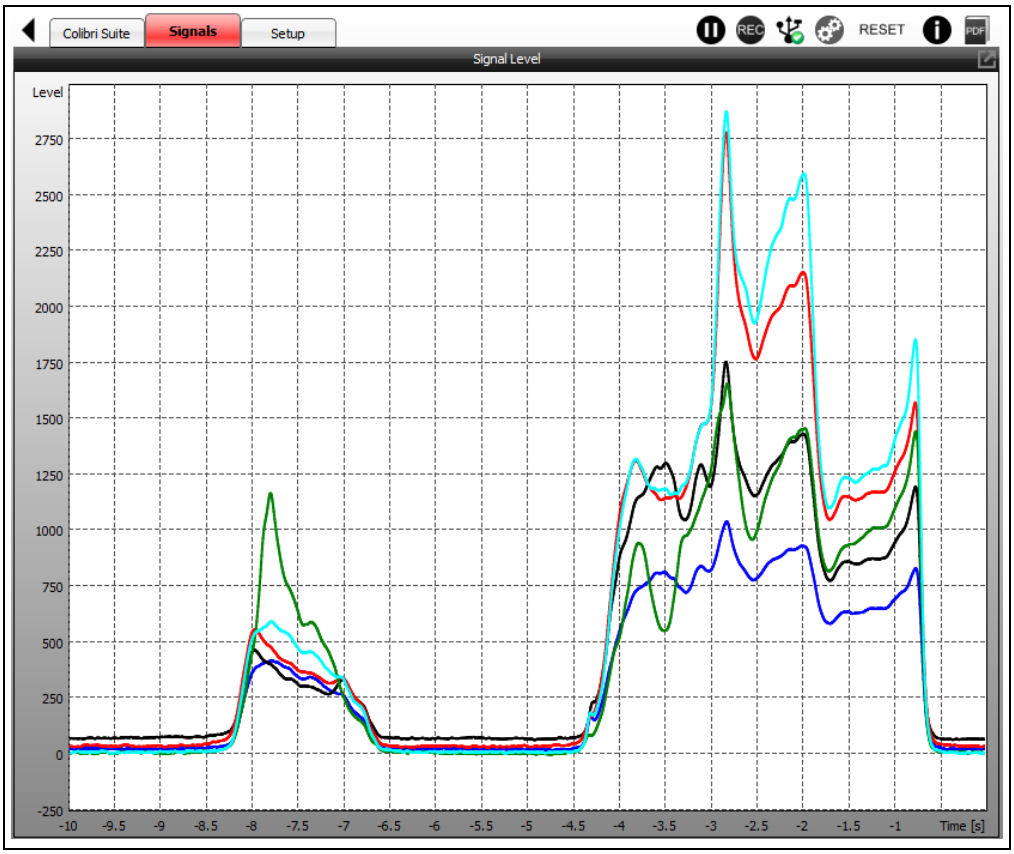
2.2.1 Signals Visualization Tab

The **Signals** tab plots the data streamed from the MGC3130 over time (see Figure 2-6). The unit of the signals is digits. On start-up, Aurea plots Signal Deviation data. The user can select the following signals in RTC (refer to **Section 2.2.2.6 "Signal Drop-down List"**):

- Uncalibrated Signal
- Signal Deviation
- Signal Deviation Mean
- Noise Level

Note: When the Approach Detection/Power-Saving feature is enabled, the MGC3130 controller is set to Sleep when no hand is present and the processing indication is turned off. In addition, the signal stream stops and the tab background turns gray. When a hand approaches the sensing area, the system will wake up.

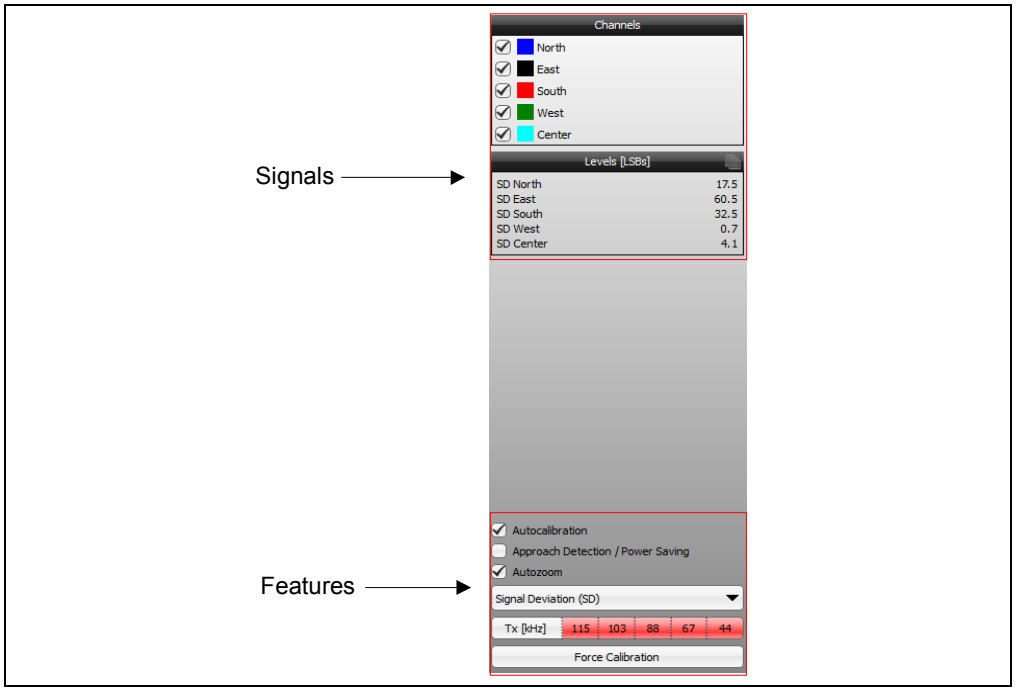
FIGURE 2-6: SIGNALS TAB WINDOW



2.2.2 Signals Real-Time Control

When **Signals** tab is active, Real-Time Control allows the configuration of the plot in the Signals window and the control of selected features applied to the MGC3130 (see Figure 2-7).

FIGURE 2-7: SIGNALS REAL-TIME CONTROL



The individual GUI elements are described below.

2.2.2.1 CHANNELS

The Channels section allows the user to select the electrode signals plotted in the Visualization window. In the standard configuration, all five channels are displayed. For a detailed look into one electrode signal, unused channels can be unchecked.

2.2.2.2 LEVELS

The most recent signal values (time = 0) are shown in the Levels section. The values can be copied and pasted to an application of your choice (e.g., Microsoft Excel®). Before selecting the values, the signal stream must be paused first by pressing the **Freeze/Unfreeze Plot** button (refer to **Section 1.2.3 "Control Bar"**).

2.2.2.3 AUTOCALIBRATION CHECK-BOX

The GestIC Library includes an Autocalibration functionality for a continuous adaptation to the environmental changes. The calibration events can be observed in the status bar (refer to **Section 1.2.4 "Status Bar "**) and in the History Logging window of the **Colibri Suite** tab. Uncheck the **Autocalibration** check-box to disable the Autocalibration feature.

Note 1:	When **Autocalibration** is disabled, a system calibration can be started by the **Force Calibration** button.
2:	When **Autocalibration** is disabled, **Approach Detection** is also disabled.

© 2013 Microchip Technology Inc.

2.2.2.4 APPROACH DETECTION/POWER-SAVING CHECK-BOX

Check the **Approach Detection/Power-Saving** check-box to enable the Approach Detection feature.

2.2.2.5 AUTOZOOM CHECK-BOX

Uncheck the **Autozoom Level** check-box to disable auto-scaling the Y axis in the Signals plot.

2.2.2.6 SIGNAL DROP-DOWN LIST

A drop-down list allows selecting the signal streamed by the MGC3130. This signal is then displayed in the plot within the **Signals** tab. The provided signals are listed in Table 2-5.

TABLE 2-5: AUREA SIGNALS

Name of Signal	Description
Uncalibrated Signal	The Uncalibrated Signal is taken directly from the decimation filter implemented in the MGC3130. Any other signals are calculated from there. Two additional indications are displayed below the Signal Level window: clipping and noise power variance. Signal peaks are observed when the automatic frequency hopping is enabled. Selecting only one frequency will avoid these peaks.
Signal Deviation	Signal Deviation shows the signals received from the electrodes after preprocessing and calibration. When there is no approach by a hand, the signals are approximately zero. A users approach causes the signal deviation to rise.
Signal Deviation Mean	The Signal Deviation Mean is the Signal Deviation with a simple moving average filter applied. The filtering is executed within Aurea with a filter length of 10 seconds. This signal is used when recording a sensitivity profile (refer to **Section 3.2 "Sensitivity Profile Acquisition"**). A pop-up window is shown during the initialization phase. It automatically disappears when data are valid.
Noise Level	The Noise Level is defined as the Standard Deviation of the Uncalibrated Signal. It is calculated over 100 seconds and gives information about the self-noise level of the sensor system. A pop-up window is shown during the initialization phase. It automatically disappears when data are valid.

2.2.2.7 AUTOMATIC FREQUENCY HOPPING LIST

Depending on the external noise conditions, the MGC3130 controller automatically chooses the best working frequency. The frequencies which are used by the AFA algorithm can be selected by checking the desired frequency box to enable it (red color). Press it again to exclude this frequency (gray color). This forces the system to continuously use only the selected frequencies. The following frequencies are available: 44 kHz, 67 kHz, 88 kHz, 103 kHz and 115 kHz.

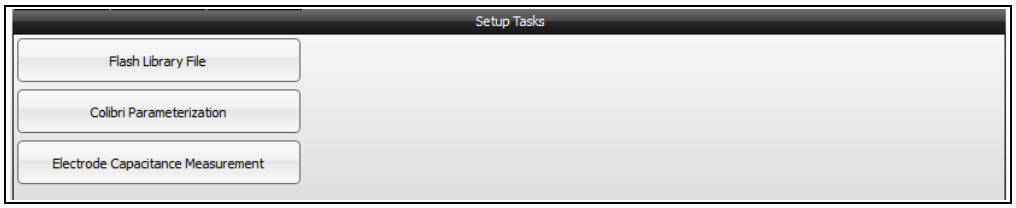
2.2.2.8 FORCE CALIBRATION BUTTON

Press **Force Calibration** to calibrate the sensor manually. Make sure the sensor is not influenced by the user when executing a calibration. The idle system is properly calibrated when the *Signal Deviation* of all channels is about zero.

2.3 SETUP

The **Setup** tab collects functions to update the GestIC Library, to adjust the hardware settings of the MGC3130, to configure the Colibri Suite (Analog Front End and Digital Signal Processing) and to measure the electrodes capacitances. Pressing one of these buttons will open the corresponding setup task (see Figure 2-8).

FIGURE 2-8: SETUP TASKS

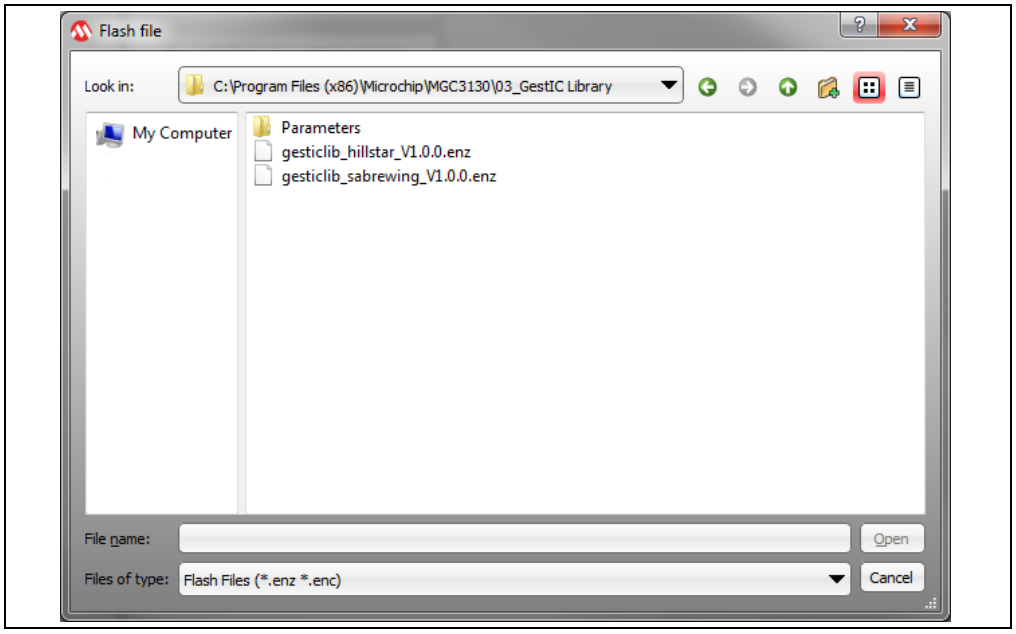


2.3.1 Flash Library File

The Flash Library File feature enables the user to flash a specific library file into the MGC3130. The library file contains a dedicated FW with a corresponding set of parameters for the dedicated target system (e.g., Hillstar Development Kit with the target electrode connected or for your MGC3130 design, respectively). The library file has the file ending `*.enz` or `*.enc`.

Pressing the **Flash Library File** button will open the following Dialogue window. Select the library file which should be flashed onto the device and press **Open** (see Figure 2-9).

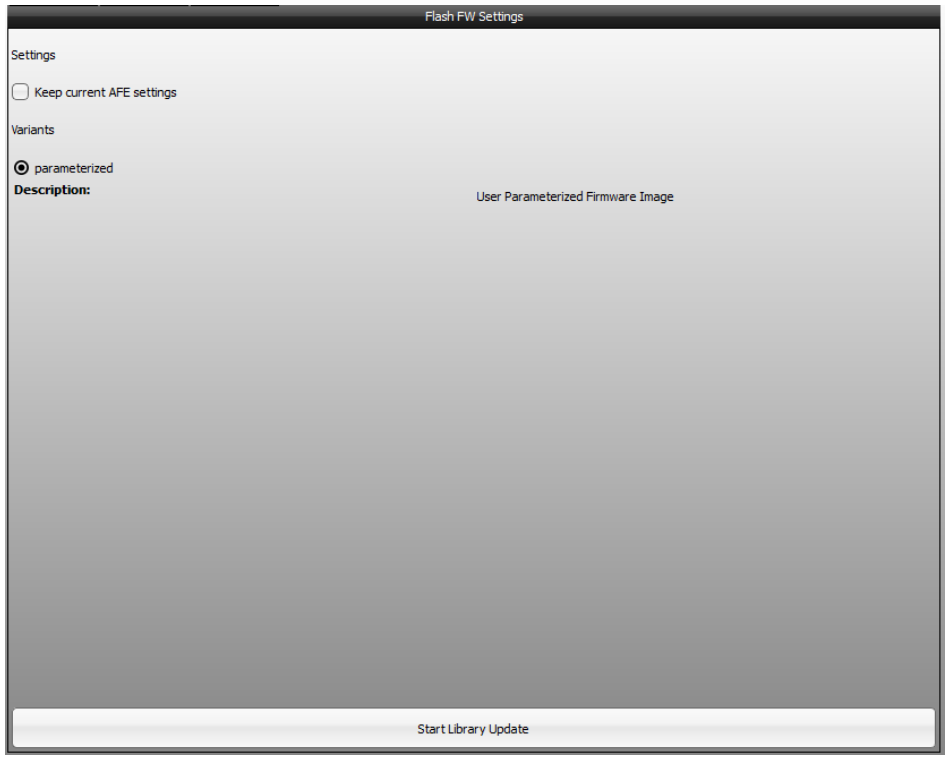
FIGURE 2-9: OPEN FLASH FILE DIALOGUE



© 2013 Microchip Technology Inc.

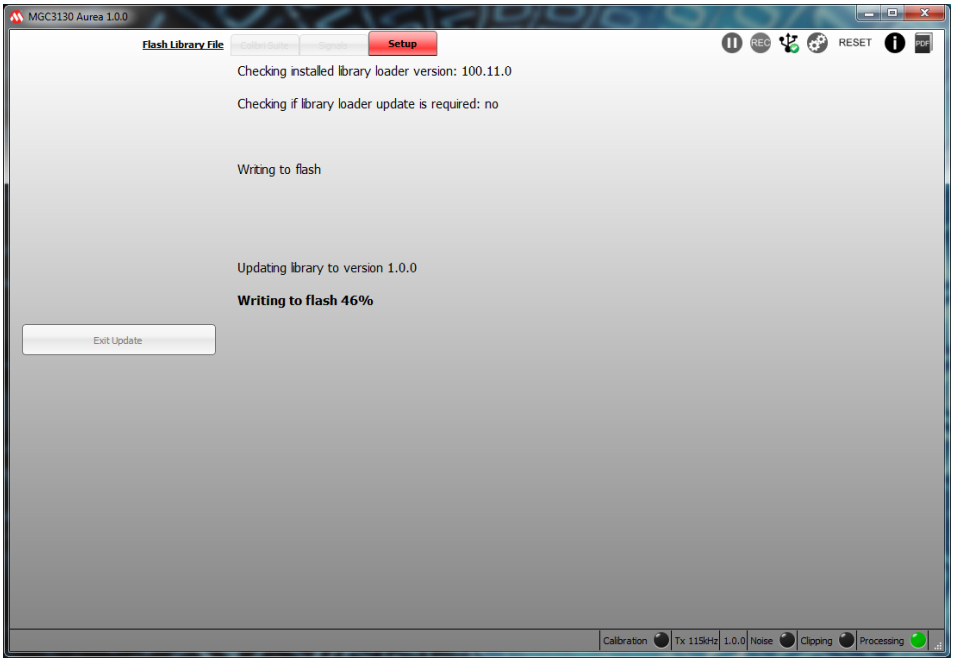
After selecting a Library file, the Flash FW Settings dialogue will occur showing the available options for the selected firmware. The user has to choose the required options and then press **Start Library Update** button (see Figure 2-10).

FIGURE 2-10: FLASH FW SETTINGS



The progress dialogue will occur and will show the status of the flash process. The dialogue can be closed after the successful Flash process by pressing **Exit** (see Figure 2-11).

FIGURE 2-11: FLASH PROCESS DIALOGUE



2.3.2 Colibri Parameterization

In order to obtain optimal functionality, the GestIC system has to be parameterized. Therefore, several rules have to be respected to match the AFE settings with electrode characteristics and match the Colibri Suite parameters with the sensitive area geometry. This chapter provides step-by-step instructions for proper GestIC parameter settings. The parameterization steps are grouped into separate sections independent from each other and displayed in Table 2-6.

The parameterization can only be done via Aurea PC Software except for real-time parameters which can be controlled as well through the I^2C messages interface.

A customer design should take this into account. For this reason, it is recommended to prepare the parameterization circuit. For more information, please refer to *"MGC3130 GestIC® Design Guide"* (DS40001716).

TABLE 2-6: GestIC® PARAMETERIZATION FLOW

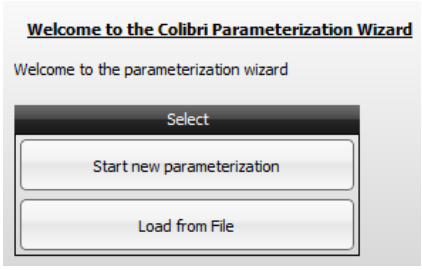
Parameterization Step	Colibri Suite Parameterization		
	Mandatory	Optional(1)	Real-Time Parameter(2)
Analog Front End	X		X
System Start-up		X	X
Position Tracking	X		
HMM Gesture Recognition		X	
Approach Detection		X	
Touch Detection		X	
AirWheel		X	
Noise Power		X	
Gesture Port		X	

Note 1: Optional parameterization steps mean that the corresponding features are expected to be functional out-of-the-box with most designs.

2: Real-Time Parameters can be controlled through the I^2C™ messages interface during runtime.

When selecting the Colibri Parameterization task, there is the possibility to start a new parameterization by using the button **Start New Parameterization** or loading an existing parameter set by clicking **Load from File** (see Figure 2-12).

FIGURE 2-12: SELECTION



2.3.2.1 START NEW PARAMETERIZATION

Clicking **Start New Parameterization** will start the Colibri Parameterization process at the first parameterization step, Analog Front End (AFE).

© 2013 Microchip Technology Inc.

2.3.2.2 LOAD FROM FILE

The Load from File feature enables the user to load a specific parameterization settings file in Aurea. The parameter settings file always has the file ending `*.enz`.

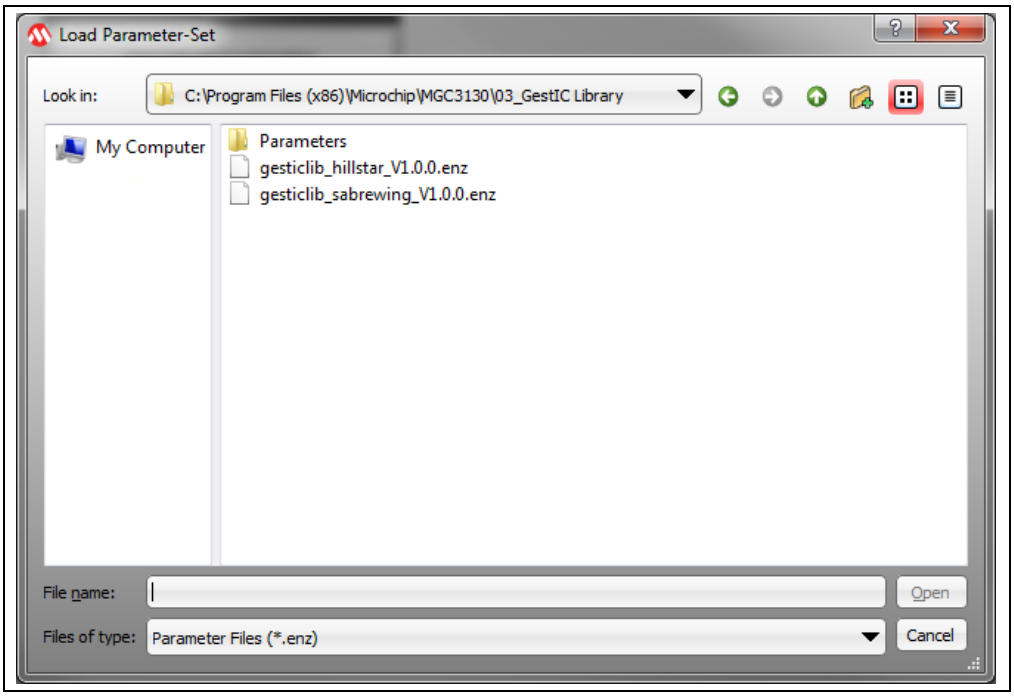
Pressing the **Load from File** button will open the Dialogue window pictured in Figure 2-13. Select the parameter file which should be loaded and press **Open**. The Colibri parameterization automatically jumps to the parameterization step where the file has been saved.

Note 1: For information about Colibri Suite Parameterization, please refer to *"MGC3130 GestIC® Design Guide"* (DS40001716).

2: If the user wants to change an existing parameterization, it is recommended to load a finalized reference parameterization and navigate to the parameters to be changed.

3: All Hillstar and Sabrewing parameterization files are located in *$\Install_Directory\Microchip\MGC3130\ 03_GestIC Library* folder.

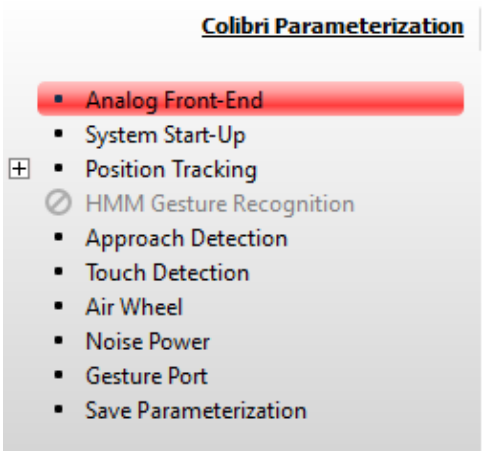
FIGURE 2-13: LOAD FROM FILE



2.3.2.3 PARAMETERIZATION PROGRESS STATE

During the whole parameterization, the Real-Time Control window will show the progress state of the parameterization (see Figure 2-14).

FIGURE 2-14: PROGRESS STATE

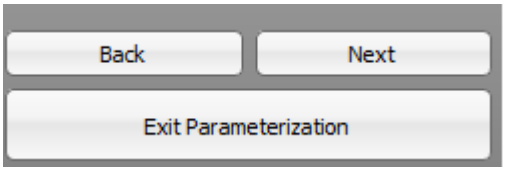


2.3.2.4 PARAMETERIZATION NAVIGATION

Navigation within the parameterization steps will be done with the two buttons **Back** and **Next** (see Figure 2-15). Do not skip steps during parameterization, as this will result into a non-functional system.

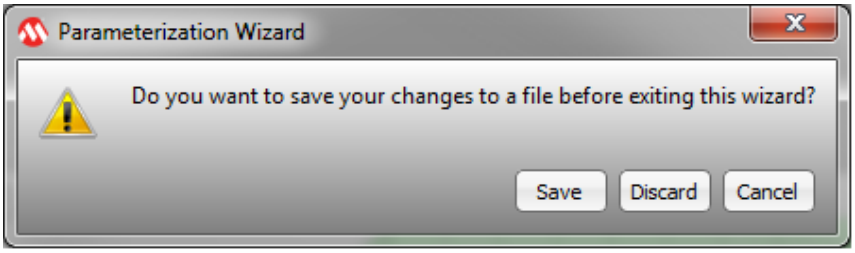
Note:	The **Next** button is used to apply the parameters of a parameterization step. Please finish each step with **Next**.

FIGURE 2-15: NAVIGATION



Clicking the **Exit Parameterization** button will open a dialogue where the user can decide whether or not to save the settings that have already been adjusted (**Save**), or close the parameterization without saving the settings (**Discard**). Clicking **Cancel** will bring the user back to the Colibri Parameterization (see Figure 2-16).

FIGURE 2-16: EXIT DIALOGUE



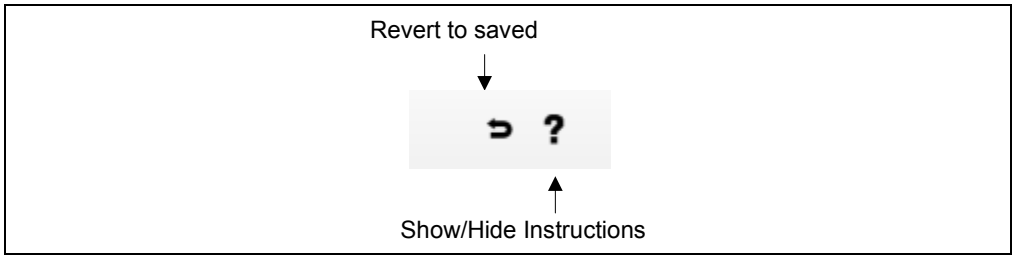
© 2013 Microchip Technology Inc.

2.3.2.5 PARAMETERIZATION OPTIONS

The parameterization options elements are valid for all Colibri Parameterization steps and are always visible across all windows. They can be accessed in the upper right corner within the parameterization wizard (see Figure 2-17). These static control elements are:

- **Revert to saved**: Press this button to retrieve the previous saved setting.
- **Show/ Hide Instructions**: Open **Help** for the current parameterization step.

FIGURE 2-17: COLIBRI PARAMETERIZATION OPTIONS

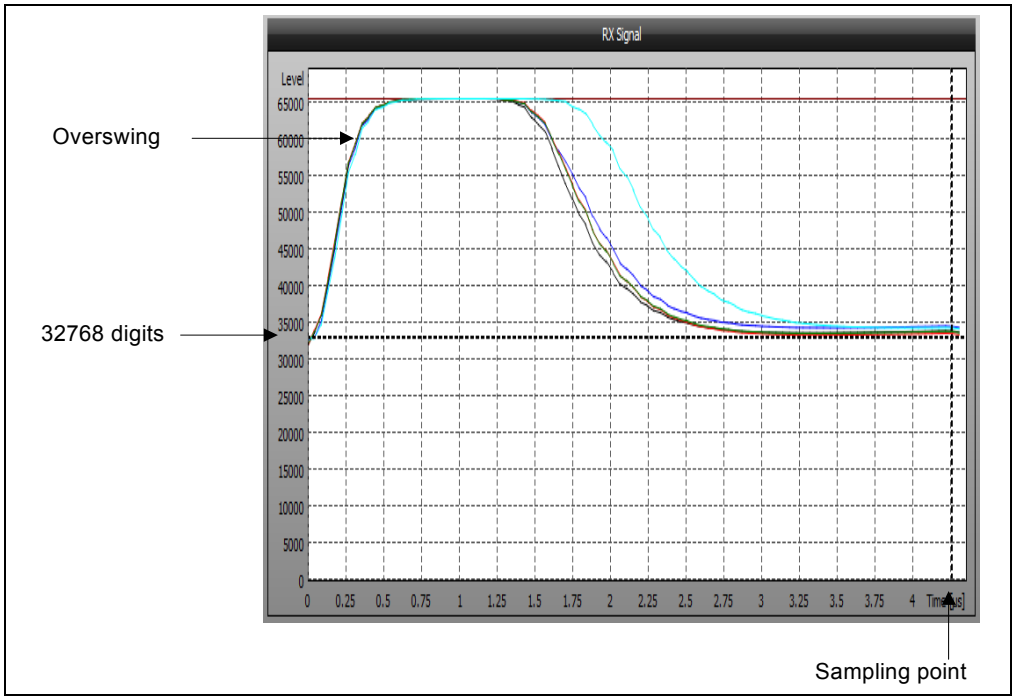


2.3.2.6 ANALOG FRONT END (AFE)

When selecting the AFE Parameterization task, the matched Rx signal is shown during the first half period of the Tx transmit signal at a working frequency of 115 kHz. The Tx transmit signal is a square wave signal. The unit is digits.

The Rx signal plot allows the user to evaluate the quality of the analog sensor signal. An optimal signal shows an overswing or underswing in the beginning and is settled at the sampling point. In addition, it should be close to 32,768 digits at the sampling point (see Figure 2-18). The overswing or underswing are determined by the capacitances of the connected electrodes (refer to *"MGC3130 GestIC® Design Guide"* (DS40001716) for more details).

FIGURE 2-18: Rx SIGNAL PLOT



The upper part of the window provides parameters to control the Analog Front End. The Analog Front End settings consist of Electrode selection, Electrode Mapping and Signal Matching. These settings can be modified by using the respective check-box or slider. For fine-tuning, click on the slider and use the arrow keys on your PC keyboard.

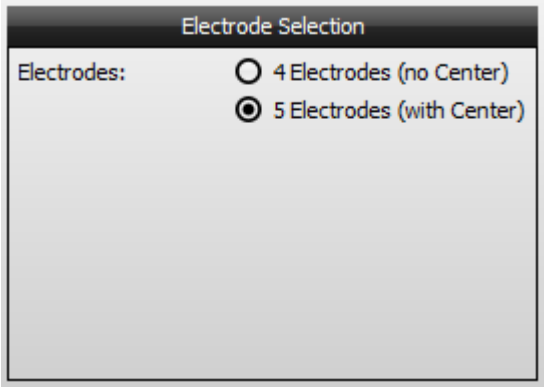
The Analog Front End settings can be stored permanently into the MGC3130 controller Flash by clicking **Store in Flash**.

© 2013 Microchip Technology Inc.

2.3.2.6.1 Electrode Selection

The optional Center electrode can be enabled or disabled by checking the **4 Electrodes (no Center)** or **5 Electrodes (with Center)** check boxes (see Figure 2-19).

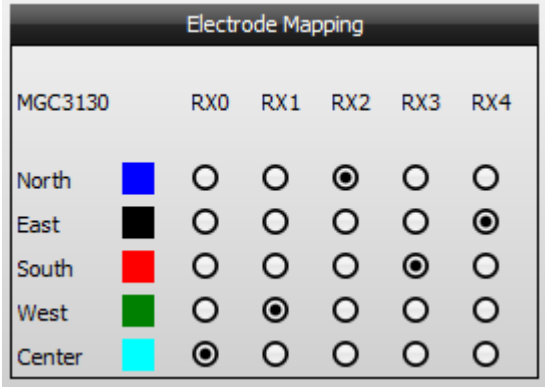
FIGURE 2-19: ELECTRODE SELECTION



2.3.2.6.2 Electrode Mapping

The electrode mapping allocates the MGC3130 Rx-pins to the outlaying electrodes (see Figure 2-20). The correct electrode mapping can be verified by touching the electrode. The corresponding electrode signal in the Rx signal plot should then increase.

FIGURE 2-20: ELECTRODE MAPPING

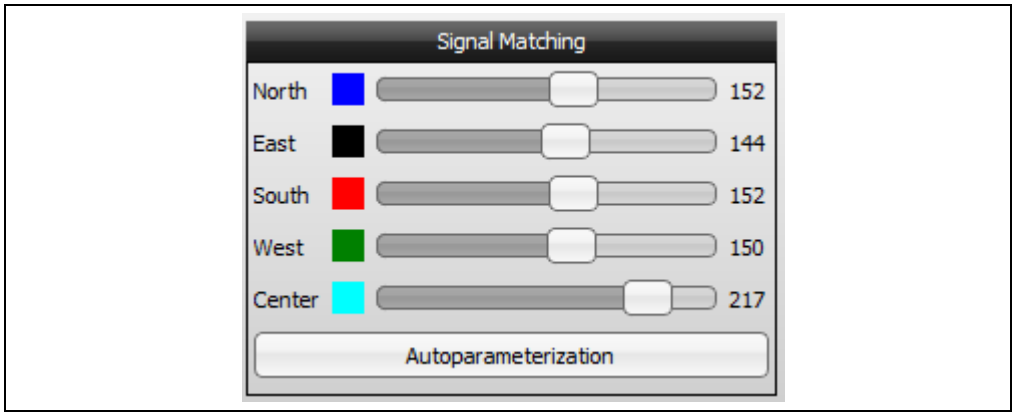


2.3.2.6.3 Signal Matching

Signal matching parameters are used to adjust the Rx signal level at the sampling point to about mid-level (32768) (see Figure 2-21).

- Increase **Signal Matching** parameters to raise the signal
- Decrease **Signal Matching** parameters to lower the signal
- Press **Auto-parameterization** to automatically signal-match all electrodes executed by Aurea

FIGURE 2-21: SIGNAL MATCHING



2.3.2.7 SYSTEM START-UP

This step configures the behavior of MGC3130 on start-up. It allows to:

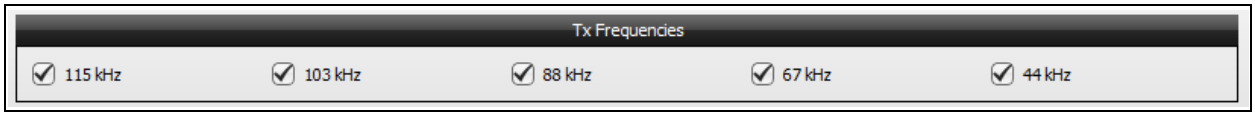
- Activate or deactivate possible working frequencies
- Configure the content of the sensor data output I^2C message
- Select the active Colibri Suite features on start-up

The settings are Run-Time Control (RTC) parameters which can be changed and saved at any time during the operation of MGC3130.

Tx Frequencies:

Depending on the external noise conditions, the MGC3130 controller automatically chooses the best working frequency. The automatic frequency hopping can be limited by unchecking one or more frequencies in the list. The following frequencies are available: 44 kHz, 67 kHz, 88 kHz, 103 kHz and 115 kHz (see Figure 2-22).

FIGURE 2-22: Tx FREQUENCIES



Sensor Data Output:

The **Sensor Data Output** I^2C message (ID 0x91) contains all data which are generated in MGC3130. That includes recognized gestures as well as continuous data such as position or raw sensor data. If data are selected (On or Dynamic), they will be added as payload elements to the sensor data output I^2C message.

There are three options for data selection (see Figure 2-23):

- Off: data will never be sent.
- On: data will always be sent.
- Dynamic: only data changes will be sent to minimize data traffic.

© 2013 Microchip Technology Inc.

FIGURE 2-23: SENSOR DATA OUTPUT

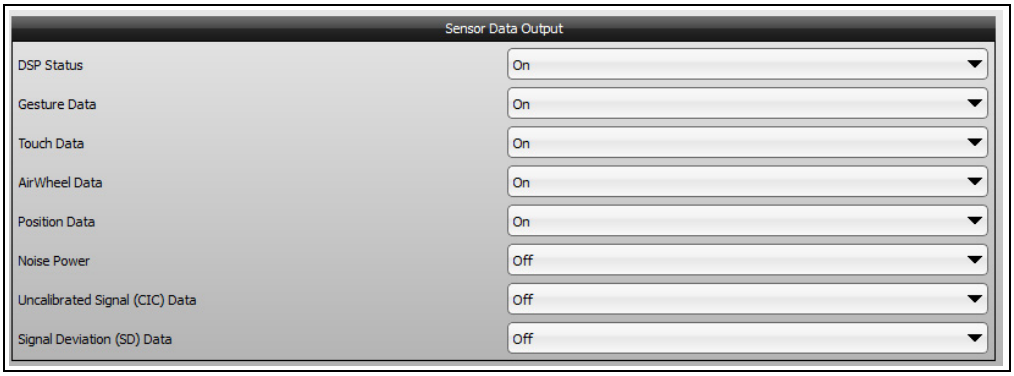


Table 2-7 lists the payload elements of the **Sensor Data Output** message.

TABLE 2-7: SENSOR DATA OUTPUT

Payload Element	Description
DSP Status	This field contains the Calibration events information and the currently used Tx frequency.
Gesture Data	This field contains the recognized gestures.
Touch Data	This field contains the Touch events information.
AirWheel Data	This field contains the AirWheel information.
Position Data	This field contains the X, Y and Z position data.
Noise Power	This field contains the current measured signal variance.
Uncalibrated Signal (CIC) Data	This field contains the Uncalibrated Signal (CIC) data.
Signal Deviation (SD) Data	This field contains the Signal Deviation (SD) data.

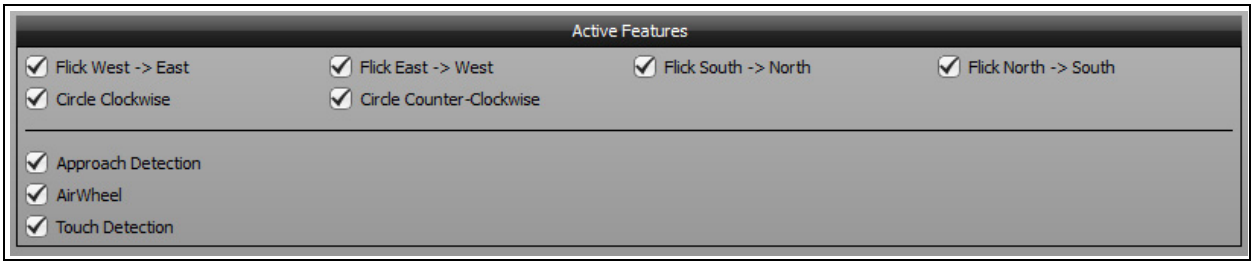
Note: A detailed description of the I²C™ message format can be found in the *"MGC3130 GestIC® Library Interface Description User's Guide"* (DS40001718).

Active Features:

The Colibri Suite features can be active or disabled on start-up (see Figure 2-24).

- **Enabled Gestures**: It selects the gestures which are active after start-up. Up to eight gestures can be selected: Flick, Circular Gestures and Touch.
- **Approach Detection**: to select if the Approach Detection feature is enabled at start-up
- **AirWheel**: to select if the AirWheel feature is enabled at start-up
- **Touch Detection**: to select if the Touch Detection feature is enabled at start-up

FIGURE 2-24: ACTIVE FEATURES



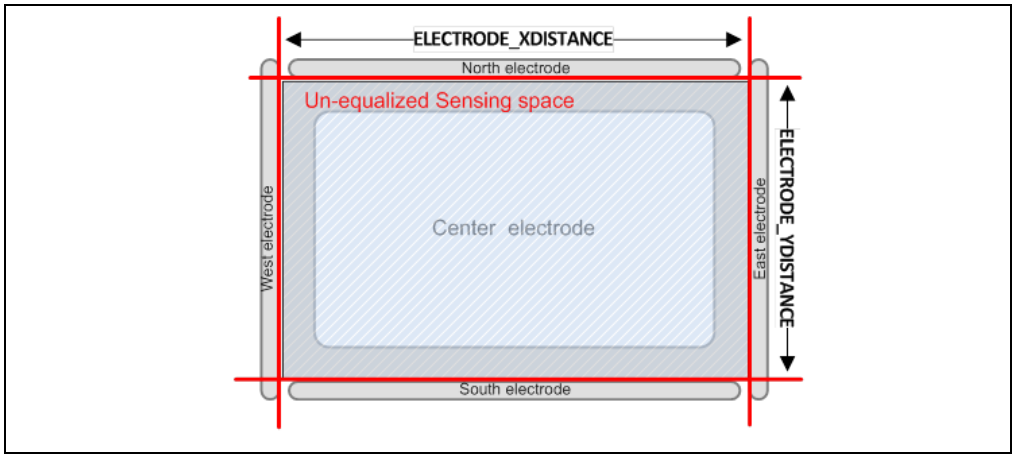
2.3.2.8 POSITION TRACKING

This section describes the Position Tracking feature parameterization.

2.3.2.8.1 Electrode Dimensions

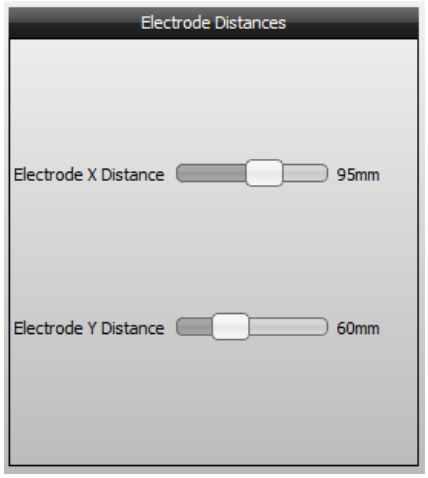
As a starting point, the user needs to input the electrode dimensions. Figure 2-25 shows how to measure the electrode dimensions.

FIGURE 2-25: UNEQUALIZED SENSING SPACE



Adjust the electrode X and Y distances by using the respective slider (see Figure 2-26). For fine-tuning, click on the slider and use the arrow keys on your PC keyboard.

FIGURE 2-26: PARAMETERIZATION STEP – ELECTRODE DIMENSION

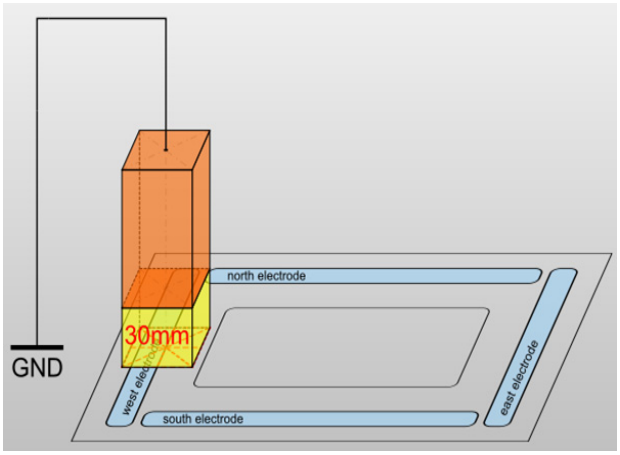


© 2013 Microchip Technology Inc.

2.3.2.8.2 Electrode Weighting

During the Electrode Weighting step, five measurements with brick and five corresponding reference measurements without a brick are conducted at a constant Z-level of 30 mm. Always use the 30 mm Styrofoam spacer brick to establish the distance between hand brick and electrodes. The drawing in the Electrode Weighting step will show where to place the brick for the current measurement (West, North, East, South and Center) (see Figure 2-27).

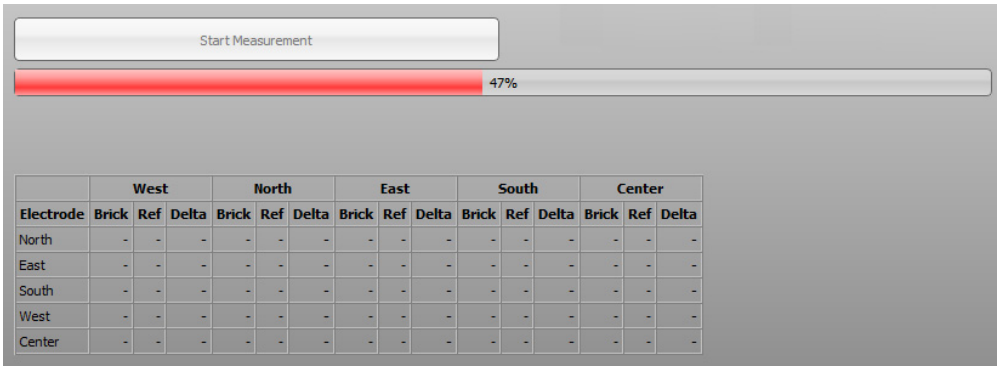
FIGURE 2-27: ELECTRODE WEIGHTING – ANIMATION BRICK POSITION



Note: It is not necessary to adjust or correct the 30 mm Styrofoam spacer brick for the thickness of the target device's housing or for a decoration layer covering the electrodes.

The button **Start Measurement** will trigger the measurement. After pressing the button, a progress bar in the Visualization window will occur (see Figure 2-28).

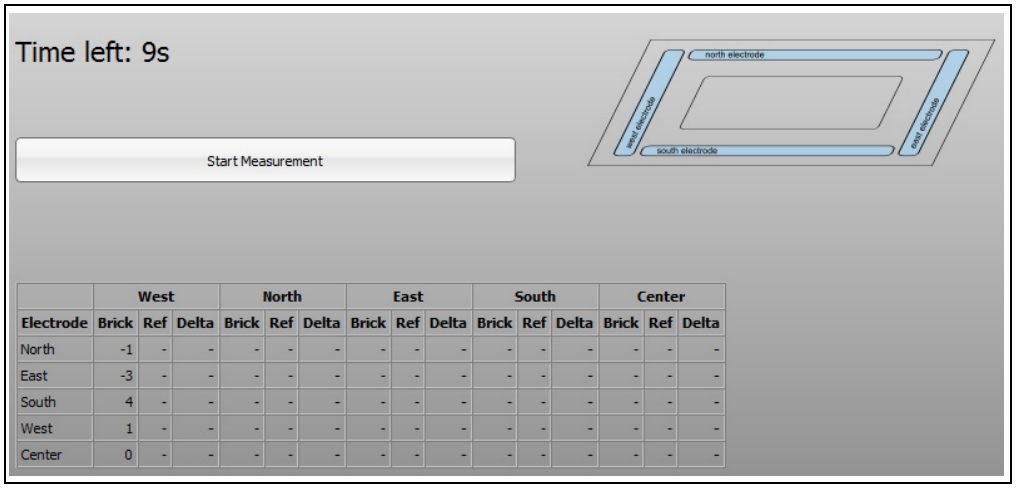
FIGURE 2-28: ELECTRODE WEIGHTING – PROGRESS BAR



	West			North			East			South			Center		
Electrode	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta
North	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Center	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

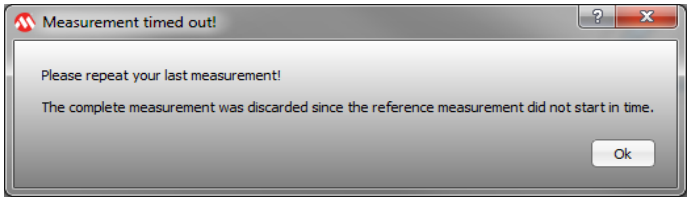
The reference needs to be measured within the next 10s to avoid influences from drifts. A down counter is displayed in the Visualization window (see Figure 2-29). If the reference measurement has not been acquired during these 10s, a pop-up window will be displayed (see Figure 2-30).

FIGURE 2-29: ELECTRODE WEIGHTING – MEASUREMENT DOWN COUNTER



	West			North			East			South			Center		
Electrode	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta
North	-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
East	-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
West	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Center	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

FIGURE 2-30: ELECTRODE WEIGHTING – MEASUREMENT TIME-OUT


Measurement timed out!
Please repeat your last measurement!
The complete measurement was discarded since the reference measurement did not start in time.
Ok

Removing the brick and pressing the **Start Measurement** button will trigger the reference measurement. A progress bar in the Visualization window will occur. The brick and reference measurements are displayed in addition to signal deviation (Delta) (see Figure 2-31).

FIGURE 2-31: ELECTRODE WEIGHTING – MEASUREMENT RESULTS

	West			North			East			South			Center		
Electrode	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta
North	136	-1	**137**	301	-7	**308**	127	-1	**129**	92	-9	**101**	253	1	**252**
East	30	-6	**35**	85	-4	**89**	248	-6	**254**	104	-6	**111**	164	-1	**165**
South	124	-1	**125**	81	0	**81**	120	-3	**123**	286	-8	**294**	276	1	**275**
West	270	-3	**273**	105	-2	**108**	38	-4	**42**	92	-5	**97**	149	-4	**153**
Center	194	-3	**196**	216	-5	**221**	190	2	**188**	228	-7	**235**	416	-4	**420**

The measurement process checks whether the measured data are valid and if the environment is noisy or not. When the data are not valid, they will be displayed in red in the measurement results table. The user has to check noise sources (PC ground, hand brick not connected to ground) and repeat the measurement.

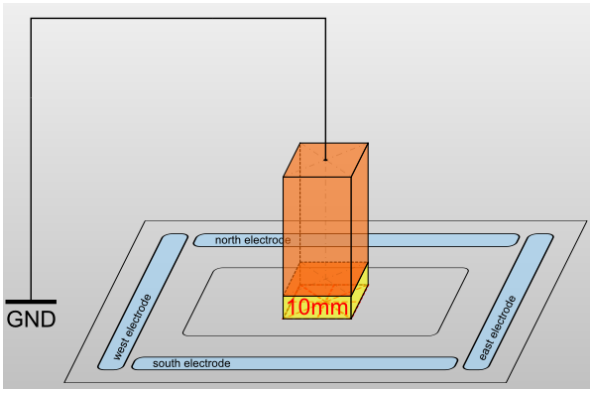
Once the Electrode Weighting step is finished, press the **Confirm Values** button.

© 2013 Microchip Technology Inc.

2.3.2.8.3 E-Field Linearization

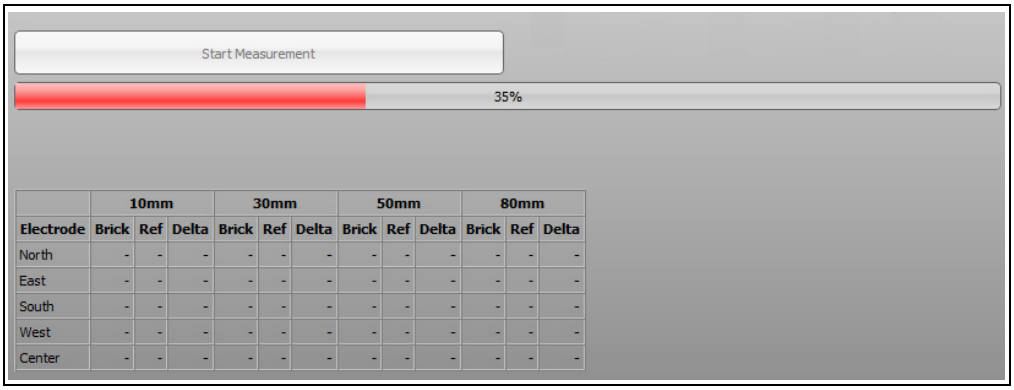
During the E-Field Linearization step, four measurements with brick and four corresponding reference measurements without a brick are conducted at the center position of the system. Always use a Styrofoam spacer brick to establish the distance between hand brick and electrodes. The drawing in the E-Field Linearization step shows the spacer brick to be used (10 mm, 30 mm, 50 mm and 80 mm) (see Figure 2-32).

FIGURE 2-32: E-FIELD LINEARIZATION – ANIMATION BRICK POSITION



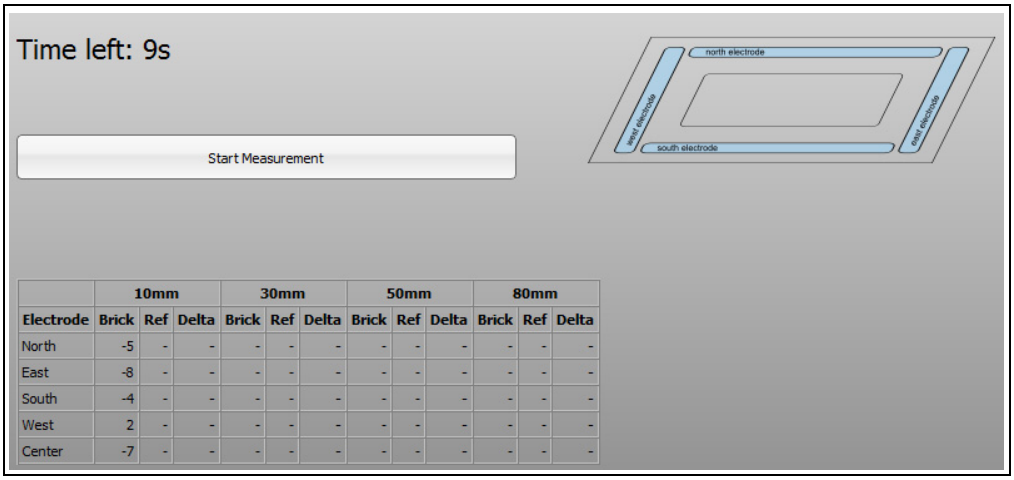
The button **Start Measurement** will trigger the measurement. After pressing the button, a progress bar in the Visualization window will occur (see Figure 2-33).

FIGURE 2-33: E-FIELD LINEARIZATION – PROGRESS BAR



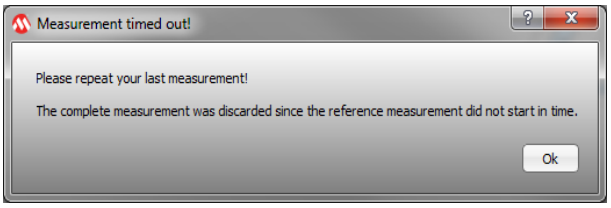
The reference needs to be measured within the next 10s to avoid influences from drifts. A down counter is displayed in the Visualization window (see Figure 2-34). If the reference measurement has not been acquired during these 10s, a pop-up window will be displayed (see Figure 2-35).

FIGURE 2-34: E-FIELD LINEARIZATION – MEASUREMENT DOWN COUNTER



	10mm			30mm			50mm			80mm		
Electrode	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta
North	-5	-	-	-	-	-	-	-	-	-	-	-
East	-8	-	-	-	-	-	-	-	-	-	-	-
South	-4	-	-	-	-	-	-	-	-	-	-	-
West	2	-	-	-	-	-	-	-	-	-	-	-
Center	-7	-	-	-	-	-	-	-	-	-	-	-

FIGURE 2-35: E-FIELD LINEARIZATION – MEASUREMENT TIME-OUT


Measurement timed out!
Please repeat your last measurement!
The complete measurement was discarded since the reference measurement did not start in time.
Ok

Removing the brick and pressing the button **Start Measurement** will trigger the reference measurement. A progress bar will occur in the Visualization window. The brick and reference measurements are displayed in addition to signal deviation (Delta) (see Figure 2-36).

FIGURE 2-36: E-FIELD LINEARIZATION – MEASUREMENT RESULTS

	10mm			30mm			50mm			80mm		
Electrode	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta	Brick	Ref	Delta
North	620	-1	**621**	223	-3	**225**	88	0	**88**	-	-	-
East	295	1	**294**	122	-4	**126**	65	0	**65**	-	-	-
South	614	1	**613**	233	0	**233**	89	1	**88**	-	-	-
West	317	2	**315**	160	1	**160**	66	1	**65**	-	-	-
Center	1570	0	**1570**	360	-2	**362**	113	-2	**115**	-	-	-

The measurement process checks if the measured data are valid or not and if the environment is noisy or not. When the data are not valid, it will be displayed in red in the measurement results table. The user has to check noise sources (PC ground, hand brick not connected to ground) and repeat the measurement.

Once the E-Field Linearization step is finished, press the **Confirm Values** button.

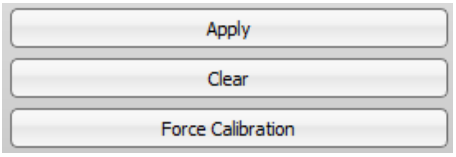
© 2013 Microchip Technology Inc.

2.3.2.8.4 Sensing Area

The Sensing Area parameterization step is intended to adapt the calculated X-Y position to the real electrode dimensions of the system. This is done by setting the four scaling parameters `X POS MIN`, `X POS MAX`, `Y POS MIN` and `Y POS MAX`. The grid of the 2D-Position plot in the Visualization window will be scaled if a slider of these parameters is moved.

The **Apply** button will apply the current setting and will rescale the Visualization window according to the current setting. The **Clear** button will reset the position drawing (see Figure 2-37).

FIGURE 2-37: SENSING AREA –– LIVE PREVIEW



The sub-steps within the Sensing Area step are the following:

a) While touching the device move with the hand posture, which is typical for the application, along the maximum XY positions which you would like to reach in your application (see Figure 2-38). Repeat the hand moving along the maximum XY position approximately 10 times to get a more meaningful drawing. The 2D-signal plot in the Visualization window draws the calculated position based on the hand movement. The real position is likely not to fit the calculated position.

b) Use the slider of the four scaling parameters to reduce the grid size until it fits within the deformed position drawing (see Figure 2-30).

c) Press **Apply** and check if it is now possible to reach all XY positions with the same hand movement.

d) Press **Next** if you can reach all positions. If not, adjust the sliders and press **Apply** again until the positioning meets your expectation.

FIGURE 2-38: SENSING AREA – HAND MOVEMENT

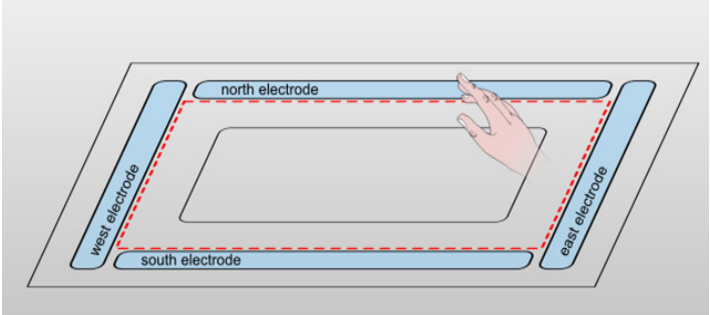
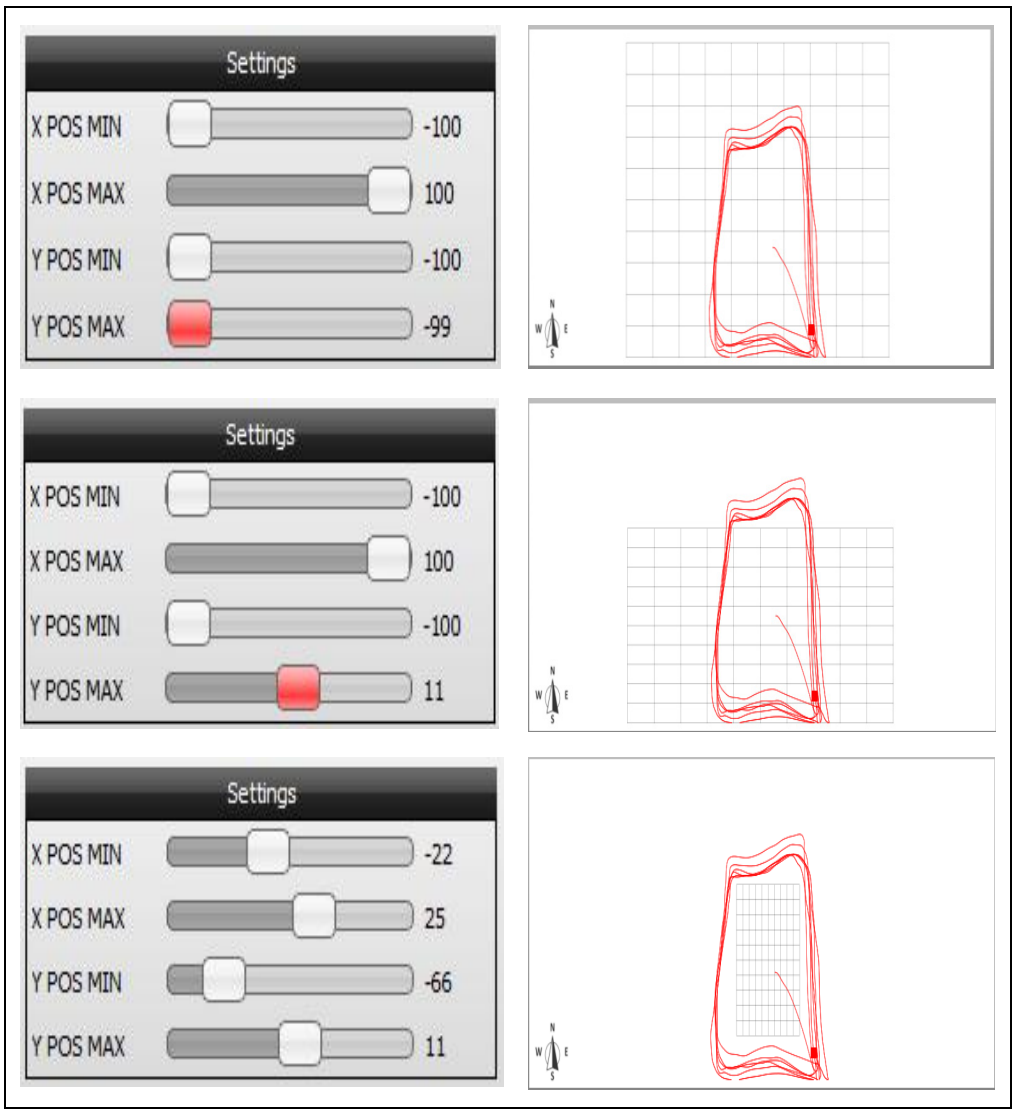


Figure 2-39 shows a typical position drawing and the parameter setting for the corresponding parameterization step. The grid and, thus, the scaling change with the parameter settings.

FIGURE 2-39: SENSING AREA – PARAMETER ADJUSTMENT



Note: Please experiment with those settings to improve the system linearity. Typically, the smaller the grid size, the more linear the system behaves.

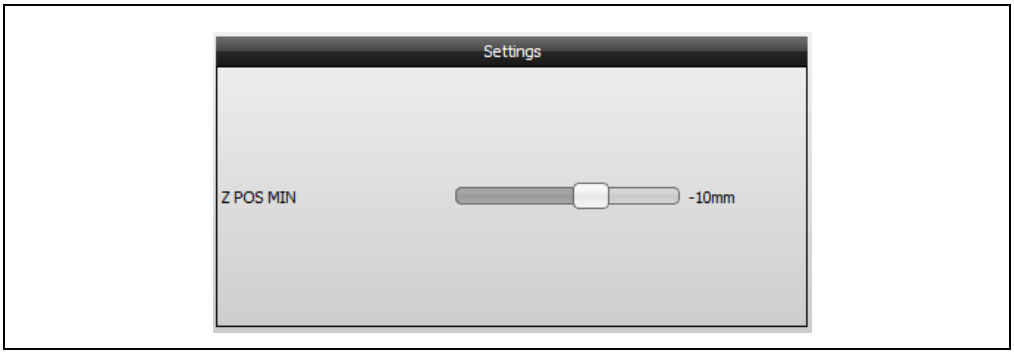
© 2013 Microchip Technology Inc.

2.3.2.8.5 Min. Distance Level

Similar to the Sensing Area step which was intended to adjust the XY positioning, the Z-positioning step is intended to adjust the Z-position calculation. Z position is adjusted through two steps: minimum and maximum Z level.

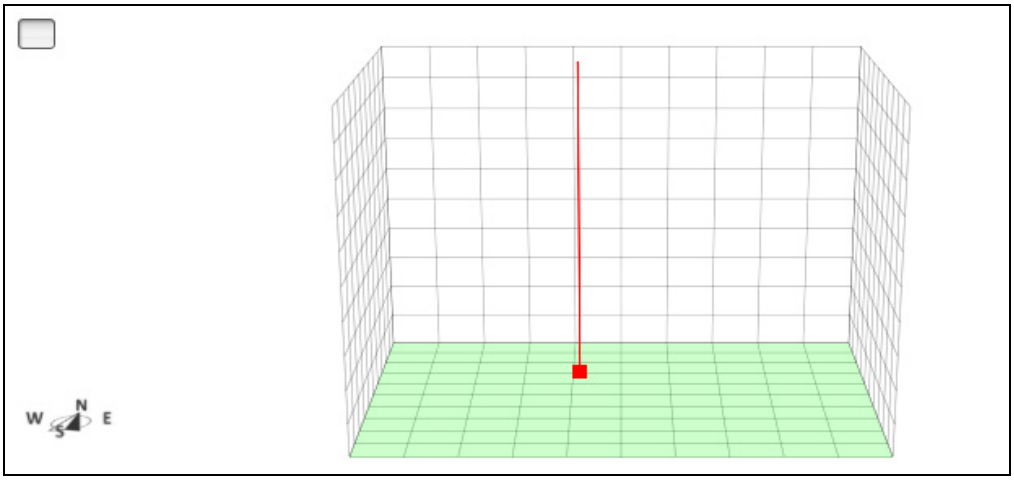
The first step is to adjust the minimum Z-distance level (Z = 0) by configuring the `Z POS MIN` parameter. This parameter can be modified by using the respective slider (see Figure 2-40). For fine-tuning, click on the slider and use the arrow keys on your PC keyboard.

FIGURE 2-40: TOUCH LEVEL – PARAMETER ADJUSTMENT



Touch the surface of the sensing area with the typical hand posture for the application and adjust the slider of `Z POS MIN` until the green Z level illustrated in the 3D-signal plot hits the *zero level*. In this manner, the *zero level* is the lowest level which is possible to reach in the 3D-signal plot (see Figure 2-41). The Z position must increase when the hand is moving up from the surface.

FIGURE 2-41: MIN. DISTANCE LEVEL



2.3.2.8.6 Max. Distance Level

The second step of the Z-position level adjustment is to identify the maximum Z-distance level. This parameter setting can be modified by using the respective slider (see Figure 2-42). For fine-tuning, click on the slider and use the arrow keys on your PC keyboard.

The sub-steps within the Max. Distance Level step are the following:

- Set `Z POS MAX` to its maximum value.
- Touch the surface and then slowly remove the hand in Z direction with a hand posture that is typical for your application.
- Z position will stop following your hand at some point.
- Adjust `Z POS MAX` so that the top of the grid is aligned with the green Z level (see Figure 2-43).

Press **Apply** and check if it is now possible to reach the maximum Z position with your hand.

FIGURE 2-42: MAX. DISTANCE LEVEL – PARAMETER ADJUST

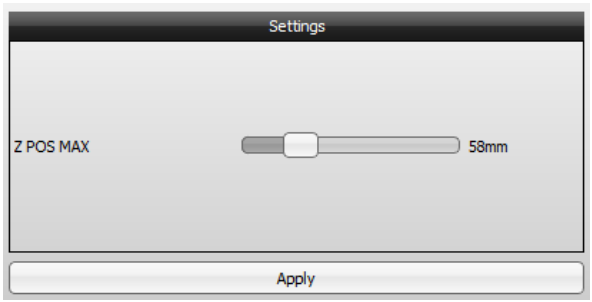
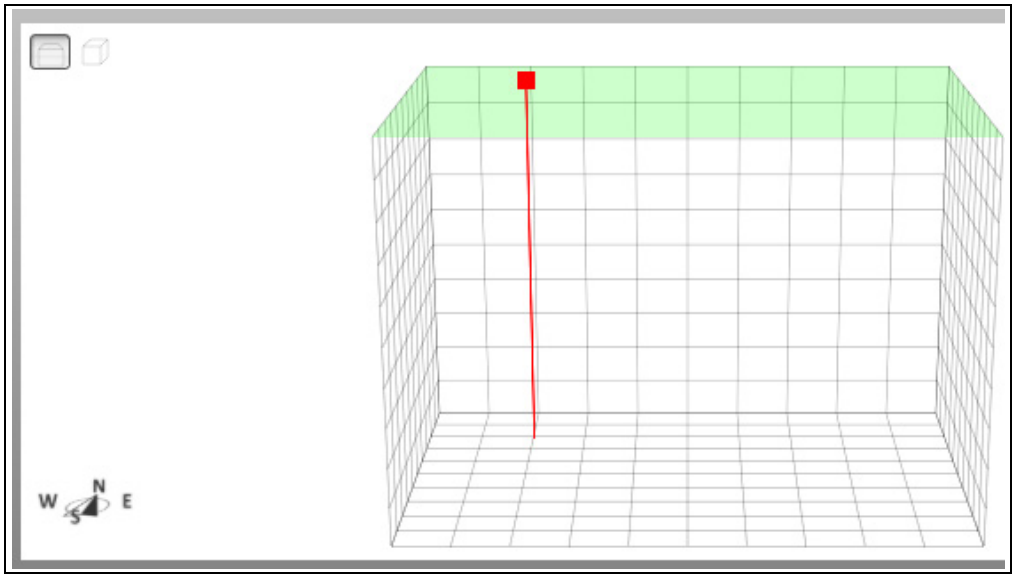


FIGURE 2-43: MAX. DISTANCE LEVEL



© 2013 Microchip Technology Inc.

2.3.2.8.7 Filter Adjustment

The filter adjustments are used to reduce the system jitter (position error when hand is stable) and to define the desired hand-tracking speed (see Figure 2-44).

Jitter Reduction

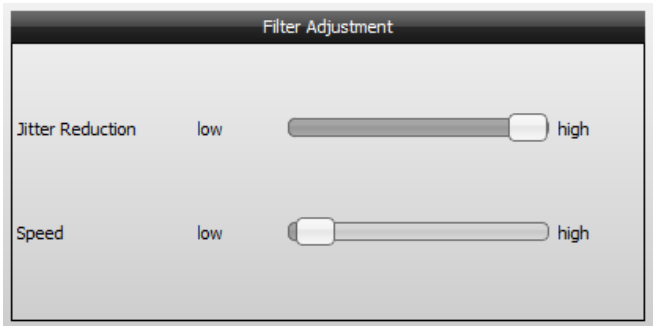
Place your hand on the corner, close to the electrodes (where the jitter is more visible), hold it for a few seconds and track the position using the Position Tracking window. The position should not have high deviation in a distance from 5-10 mm.

Increase the Jitter Reduction parameter value to reduce system jitter. High values will lead to a more lethargic system behavior. A high jitter reduction setting will also slow down the tracking speed and the other way around.

Speed

Use hand gestures to check the tracking speed and track the speed using the Position Tracking window. Increase or decrease the Speed parameter value to speed up or to slow down the tracking speed.

FIGURE 2-44: FILTER ADJUSTMENT



2.3.2.9 HMM GESTURE RECOGNITION

The Colibri Suite uses Hidden Markov Models (HMM) providing user-independent gesture recognition. Gesture recognition starts when a hand enters the sensing area or when a movement is detected after a resting period. A gesture ends when the hand leaves or rests inside the sensing area. Gestures can have various sizes and can be performed at various speeds within defined limits. For instance, gesture recognition does not trigger when the movement of a gesture is very slow or particularly fast.

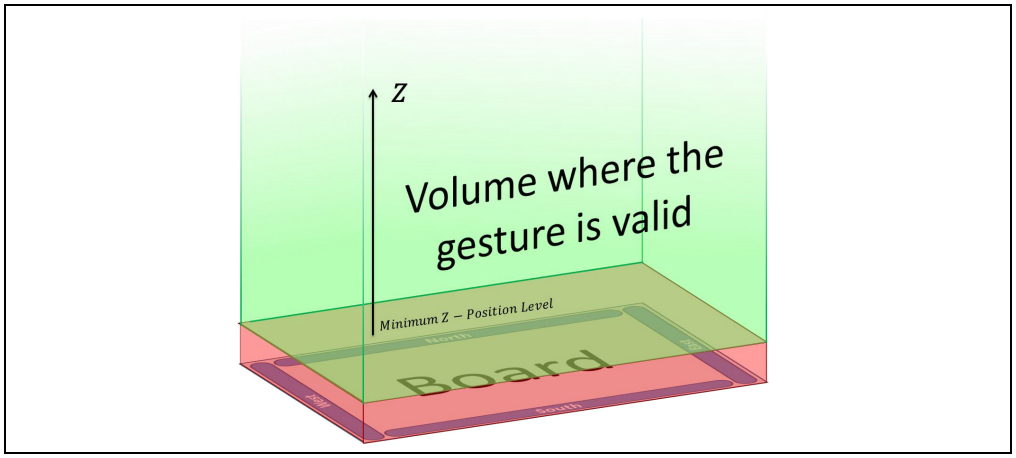
The gestures settings provided within this step are (see Figure 2-46):

- **Trigger Calibration**
- **Z-Position Limit for Gesture Recognition**
- **Minimum and Maximum Duration**
- **Detection Sensitivity**
- **Recognition Aggressivity**
- **Suppression Time**

These parameters can be modified by using the respective slider. For fine-tuning of the parameters, click on the slider and use the arrow keys on your keyboard. The Gestures and XYZ Position visualization windows give immediate feedback upon parameter adjustment.

- **Trigger Calibration**: The Colibri Suite provides the functionality to calibrate the sensor manually (adapt the electrode system to environmental changes). It is recommended that the sensor is not influenced by the user when executing a calibration. Colibri Suite can use flick gestures to force a system calibration, as it is expected that, by the end of the Flick event, the hand has already crossed the entire sensitive area. The idle system is properly calibrated when the Signal Deviation of all channels is at or near zero. Immediate feedback is given by the calibration indication in Aurea Status Bar. Each time a selected gesture is performed, the calibration indication blinks. To select the gestures which are used to trigger a Colibri Suite calibration, check the corresponding check-box. Up to four flick gestures can be selected.
- **Z-Position Limit for Gesture Recognition**: This step allows selecting the gestures which should have a **Z-Position Limit for Gesture Recognition** (see Figure 2-45) and define the **Minimum Z-Position Level** for each gesture independently. These gestures are only valid if, during the entire gesture execution, Z position is above the defined **Minimum Z-Position Level**. Gestures can be selected using the corresponding check-box. If the system has no restrictions on gestures height, this feature can be disabled by unchecking the corresponding check-box (see Figure 2-45).

FIGURE 2-45: MINIMUM Z-POSITION LEVEL



© 2013 Microchip Technology Inc.

The **Minimum Z-Position Level** can be modified by using the respective slider. For fine-tuning, click on the slider and use the arrow keys on your PC keyboard. The range for this slider is 0 to 65535.

To adjust **Minimum Z-Position Level**, please proceed as follows:

1. Adjust the slider of **Min Z-Position Level** to the maximum value.
2. Perform the gesture with the typical hand posture for the application and at the minimum distance desired for the application.
3. Decrease the value until the gestures are correctly recognized. Lower values mean gestures can be recognized at lower Z-position levels. Gestures performed at higher distances should be recognized.

Note 1:	Only flick and discrete circular gestures can be selected.
2:	This feature depends on correct parameterization of **Position Tracking**. Without it, Z position can be erroneous and lead to bad recognition performance.

- **Gesture Duration**: This step selects the gestures which should have duration limits and define the minimum and the maximum duration for each gesture independently. These gestures are only valid if their durations are in the range of the minimum and maximum values.

  Min Duration: It specifies the minimum amount of time that gestures have to last in order to be detected.

  Max Duration: It specifies the maximum amount of time that gestures should not exceed in order to be detected. This limit is always higher than the **Limit Min Duration**.

  Min Duration < Gesture Duration < Max Duration

Gestures can be selected using the corresponding check-box. If the system has no restrictions on gestures duration, this feature can be disabled by unchecking the corresponding check-box.

The minimum and maximum durations can be modified by using the respective slider. For fine-tuning, click on the slider and use the arrow keys on your PC keyboard. The range for this slider is 0 to 2000ms.

To adjust **Min and Max Duration Time**, proceed as follows:

1. Adjust the slider of **Min Duration** to a higher value.
2. Perform the corresponding gestures with the highest speed allowed for the application.
3. Decrease the slider until the gestures are recognized correctly.
4. Adjust the slider of **Max Duration** to a lower value, above **Min Duration**;
5. Perform the corresponding gestures with the lowest speed allowed for the application.
6. Increase the slider until the gestures are recognized correctly.

- **Detection Sensitivity**: It is a gain which needs to be adjusted depending on expected system noise. With low values, gestures have to be performed very close to the electrodes. High values increase sensitivity but are also less robust. The Detection Sensitivity values range between 0,01 and 10 digits.

> **Note:** Very high sensitivity can prevent the system from working properly, since gesture recognition can be trigged by noise without any hand present in the sensitive area.

To adjust **Detection Sensitivity**, please proceed as follows:

1. For maximum robustness to noise:
   a) Perform gestures as far away from the sensitive area as allowed by the application.
   b) Reduce **Detection Sensitivity** until gestures are no longer detected.
   c) At this point, amplitude from performed gestures is not enough to trigger gesture start. This is approximately the minimum sensitivity of the application.
2. For maximum system sensitivity:
   a) Perform gestures close to the sensitive area.
   b) Increase **Detection Sensitivity** until gestures are no longer detected.
   c) At this point, noise amplitude is enough to trigger gesture start. Noise is mixed with the performed gesture signal and no valid gesture is recognized. This is approximately the maximum sensitivity of the application.

- **Recognition Aggressivity**: This parameter defines how exact gestures have to be performed in order to be recognized. **Recognition Aggressivity** will scale the probability threshold defined for each gesture.

  High Aggressivity will classify a gesture even if it has been very inaccurately performed (e.g., half circle classified as circle, diagonal flicks as flick etc.). Low Aggressivity yields a cautious system that only recognizes a gesture when it has been accurately performed (e.g., the user must perform a very round complete circle or several circles).

  The Recognition Aggressivity can be modified by using the corresponding slider. For fine-tuning, click on the slider and use the arrow keys on your PC keyboard. The range for this slider is -1 to 1.

> **Note:** This parameter also affects the AirWheel recognition.

To adjust **Recognition Aggressivity**, proceed as follows:

1. Increase **Recognition Aggressivity** to the maximum value.
2. Perform gestures in the most relaxed way the application will allow.
3. Decrease **Recognition Aggressivity** until these gestures are no longer recognized. The value achieved is the maximum Aggressivity allowed for the gesture performance.

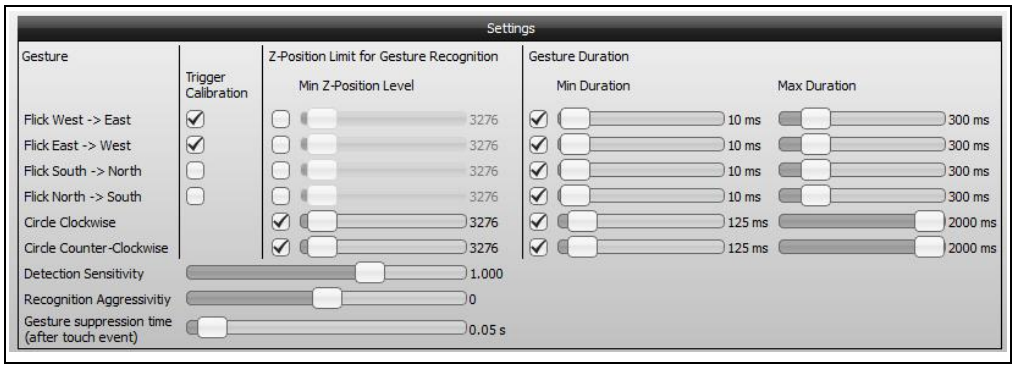
© 2013 Microchip Technology Inc.

- **Gesture suppression time**: Adjusts the time for which gestures are not allowed after sensor touch detection (Touch, Tap or Double Tap). The range is from 0 to 1.25s.

  After touching, when removing hand, the user can unintentionally trigger a gesture. This feature can prevent this situation.

Note 1:	If this Gesture suppression time parameter is active (>0), touches also abort ongoing gesture recognition.
2:	This parameter can be used only when the Touch Detection feature is enabled; otherwise, it has no impact.

FIGURE 2-46: HMM GESTURE RECOGNITION

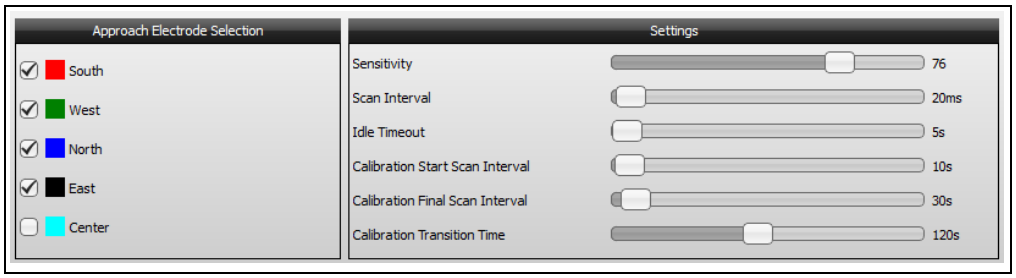


2.3.2.10 APPROACH DETECTION

The Real-Time Control part of this step covers all parameters controlling Approach Detection feature (see Figure 2-47).

- *Approach Electrode selection*: to select which electrodes are active during Approach Detection mode
- *Settings*:
  - *Sensitivity*: to adjust the wake-up sensitivity. High values will lead to a more sensitive wake-up behavior (false approach). Low values reduce false wake-ups.
  - *Scan Interval*: to adjust the Approach Scan timing interval.
  - *Idle Time-out*: to adjust the inactivity time after which the system will enter the Approach Detection mode.
  - *Calibration Start Scan Interval*: to adjust the start Calibration Scan timing interval.
  - *Calibration Final Scan Interval*: to adjust the final Calibration Scan timing interval.
  - *Calibration Transition Time*: to adjust the transition time between *Calibration Start Scan Interval* and *Calibration Final Scan Interval.*

FIGURE 2-47: APPROACH DETECTION – PARAMETERS ADJUSTMENT



Note 1:	Shorter Approach Scan Interval times result in a more responsive system, where it is possible to detect even slow gestures during the wake-up phase.
2:	Shorter Approach Scan Interval times result in higher average power consumption.

© 2013 Microchip Technology Inc.

2.3.2.11 TOUCH DETECTION

The Real-Time Control part of this step covers all parameters controlling the Touch Detection feature (see Figure 2-49).

- **Threshold Settings**: **Touch Threshold North**, **East**, **South**, **West**, **Center**: This field specifies the SD values that have to be exceeded to validate the touch event. The range is 0 to 32000 LSB. The horizontal line in the Level window is adjusted according to the slider value.

  The sub-steps within the **Touch Detection Threshold** settings step are the following:

  1. Touch each electrode in its geometric center and move your finger to the borders of the electrode while touching.
  2. Adjust corresponding **Touch Threshold** according to the displayed SD value while your finger is positioned on the electrode. If touches are missed, you may need to decrease the **Touch Threshold**.
- **Release Threshold**: Touch state is released if SD value drops below a threshold which is calculated by **SD value on Start of Touch * Release Threshold**. The slider can be adjusted between 50% and 100%.
  - Touch each electrode in its geometric center and change the hand posture. If touch state becomes released though you are still touching, decrease **Release Threshold**. If you lift your finger from the surface, but touch state is still signaled, increase **Release Threshold**.
- **Tap Settings**:
  - **Single Tap Delay**: A Single Tap is detected when the timing between a touch and the release of the touch event is smaller than the adjusted delay **Max Tap Duration** (see Figure 2-48). Increasing the time gives you more time to perform the tap. The range for the adjusted delay can be between 0s and 1s.
  - **Double Tap Delay**: The double tap is detected when two taps are performed within the adjusted delay **Max Double Tap Duration** (see Figure 2-48). The range for the adjusted delay can be adjusted from 0s to 1s. The smaller the selected delay is, the faster the two taps have to be executed.

FIGURE 2-48: TOUCH DETECTION

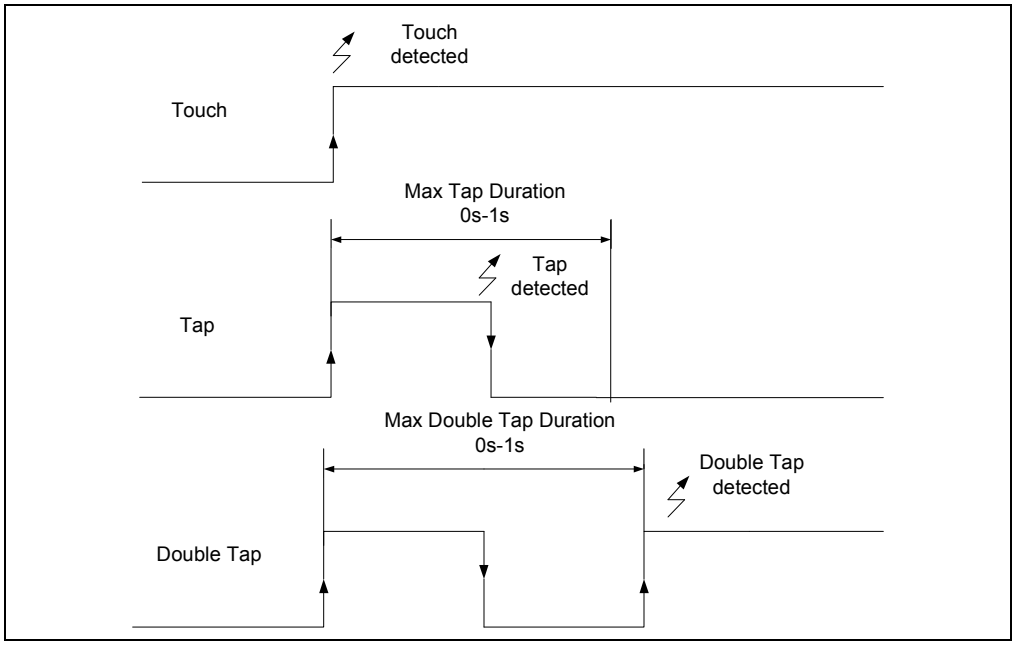
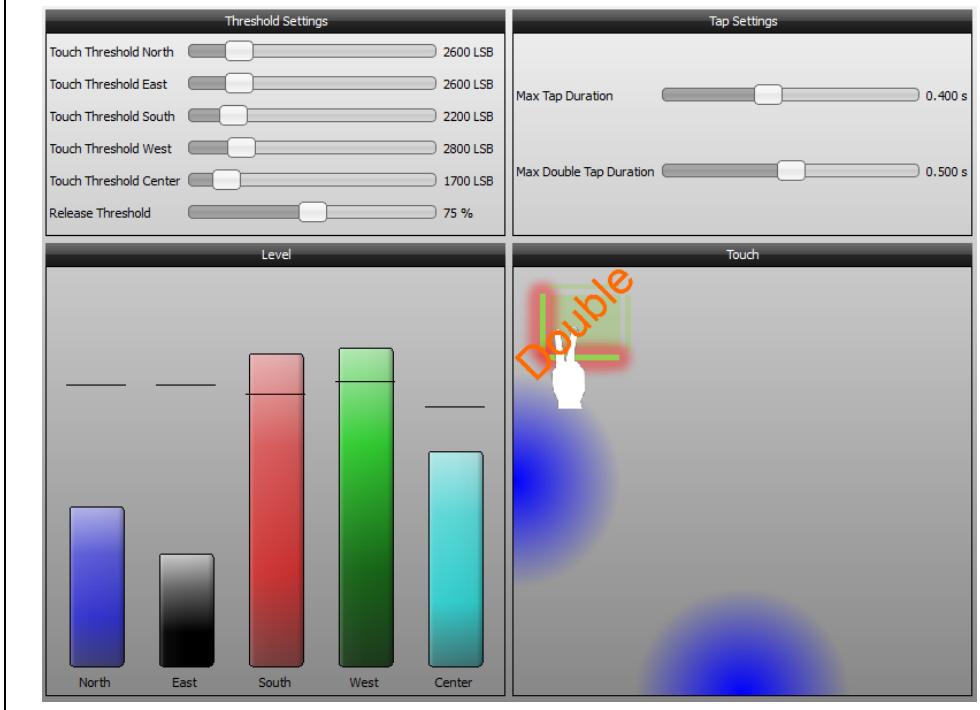


FIGURE 2-49: TOUCH DETECTION – PARAMETERS ADJUSTMENT

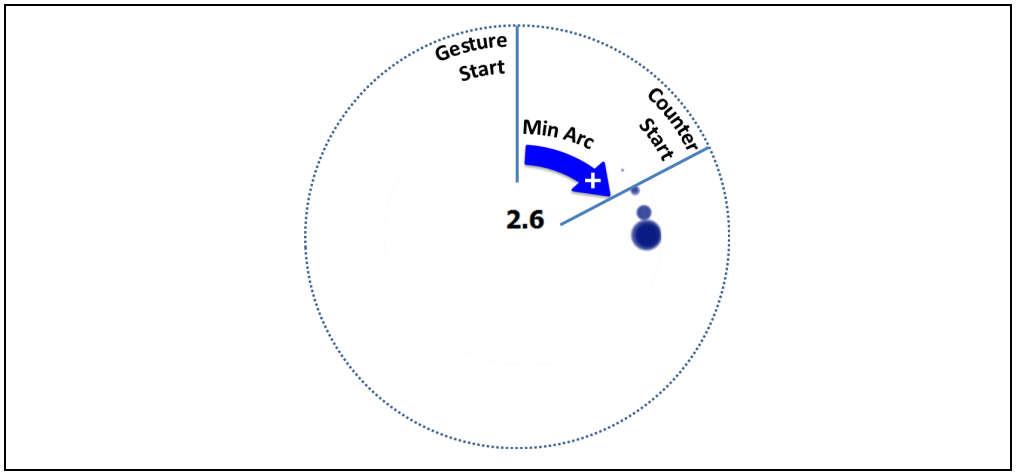


2.3.2.12 AIRWHEEL

The AirWheel is part of the Colibri Suite's circular gestures. It provides a counter which can be either increased or decreased. It increases with clockwise circles and decreases with counter-clockwise circles, being possible to invert direction while gesture is ongoing.

The output value accumulates the angle change during circular movement. Its resolution is around 32 counts per full circle, but it may depend on configuration parameters and sensor board layout. Aurea displays the direction and the counter (see Figure 2-50).

FIGURE 2-50: POSITIVE DIRECTION AND MINIMUM ARC REPRESENTATION



© 2013 Microchip Technology Inc.

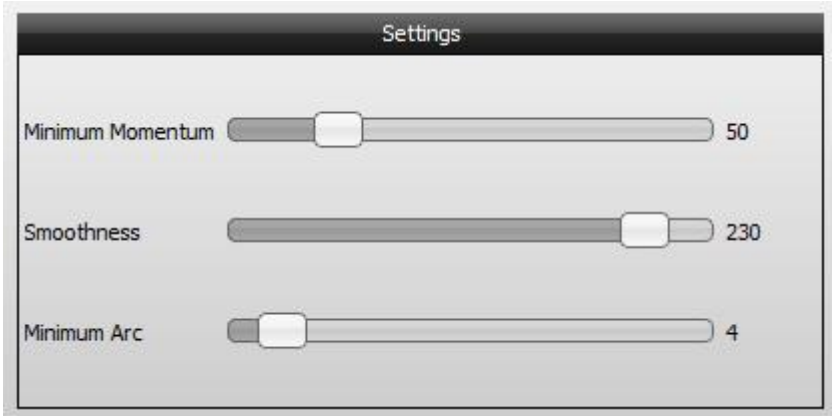
Though it is expected to work out-of-the-box with most designs, the AirWheel's parameterization can be adjusted using only three customizable settings (see Figure 2-51).

- **Minimum Momentum**: This value changes the amount of movement required to update the AirWheel counter. High values improve robustness against small changes such as jitter. With smaller values, AirWheel is faster to react but also more affected by jitter, but it may be necessary to move the finger closer to the sensor board. The values for the minimum momentum range from 0 to 255 digits.
- **Smoothness**: The Smoothness value influences the speed and smoothness of the counter. For low values, the counter changes slowly. For high values, the counter changes quickly. Smaller arcs correspond to higher counts. The Smoothness value can be adjusted from 0 to 255 digits. Most applications will require that the chosen smoothness is as high as possible. This will avoid having AirWheel counter jump or misbehave with fast circles.
- **Minimum Arc**: It adjusts how much the user should rotate before the AirWheel counter starts. A higher value means that a bigger arc has to be performed before counter starts. The values can be changed from 0 to 64.

Note 1: The Minimum Arc setting affects both discrete HMM circle gestures (events) and the AirWheel.

2: A circle event is only recognized if this same minimum arc is performed.

FIGURE 2-51: AIRWHEEL – PARAMETERS ADJUSTMENT



2.3.2.13 NOISE POWER

GestIC Library includes a noise power estimation, which is displayed in the Variance window (see Figure 2-52). Depending on the noise power, the user can select to turn off the GestIC features.
Three sliders can be used to adjust the maximum variance limit for **Gesture Recognition** (flicks and circles), **Position Tracking** and **Touch Detection** (see Figure 2-53). All three limits are displayed in the Variance display. If a slider is pulled completely to the left side (Off), the corresponding feature will always be On, regardless of the noise power. Experiment with different noise sources to judge the noise power level at which you want a feature to be disabled. The range can be adjusted from Off, 0.1 to 50 LSBs. Default value is Off.

FIGURE 2-52: NOISE POWER – THRESHOLDS

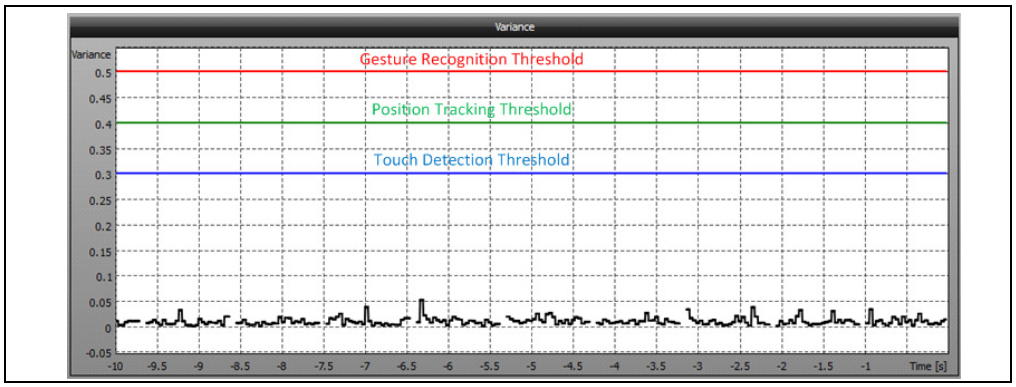
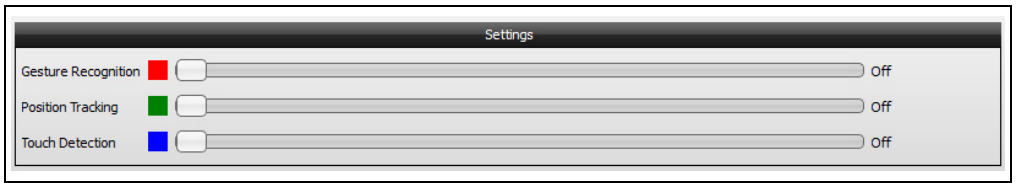


FIGURE 2-53: NOISE POWER – PARAMETERS ADJUSTMENT

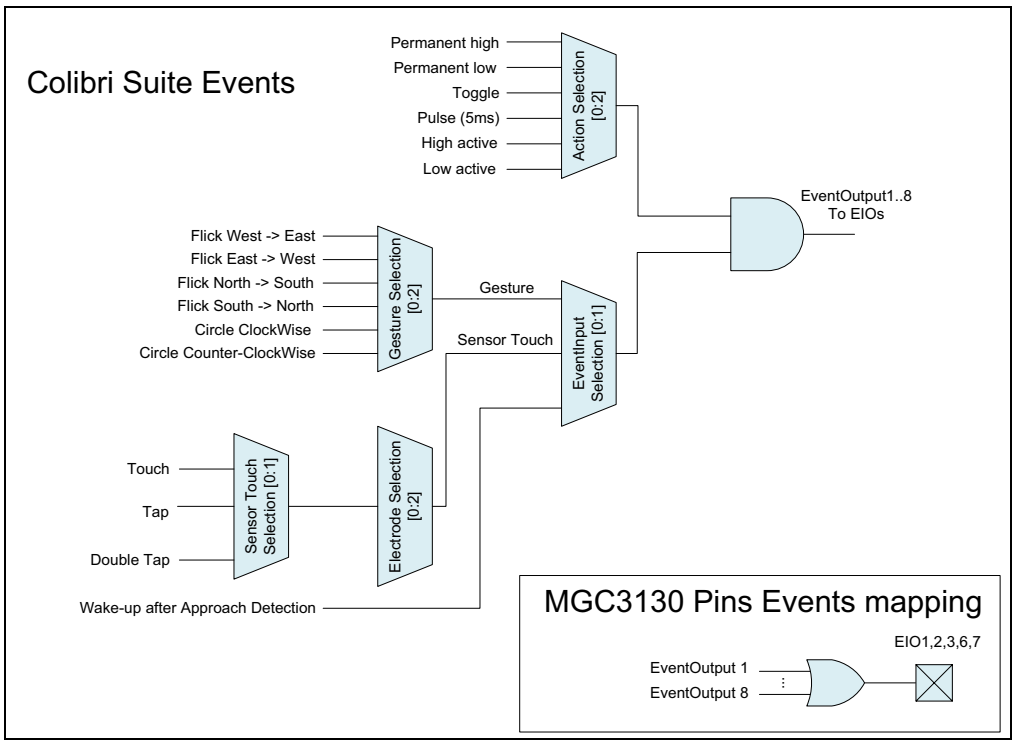


© 2013 Microchip Technology Inc.

2.3.2.14 GESTURE PORT

This configuration step allows the set-up of the Colibri Suite Gesture Port events (for example, switching a connected light on or off with one or more gesture events). The Colibri Suite can generate up to eight event outputs which can be mapped to any EIO (1, 2, 3, 6 or 7). It is also possible to map more than one event output by one EIO (see Figure 2-54).

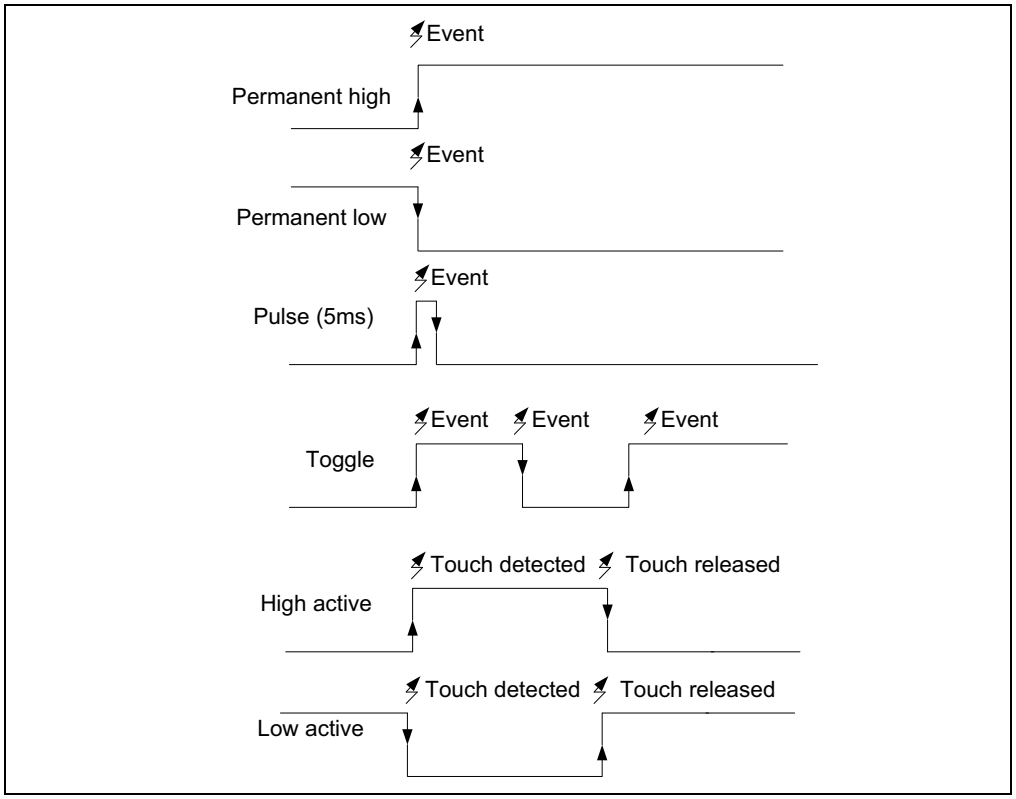
FIGURE 2-54: GESTURE PORT MAPPING



The sub-steps within the Gesture Port settings step are the following:

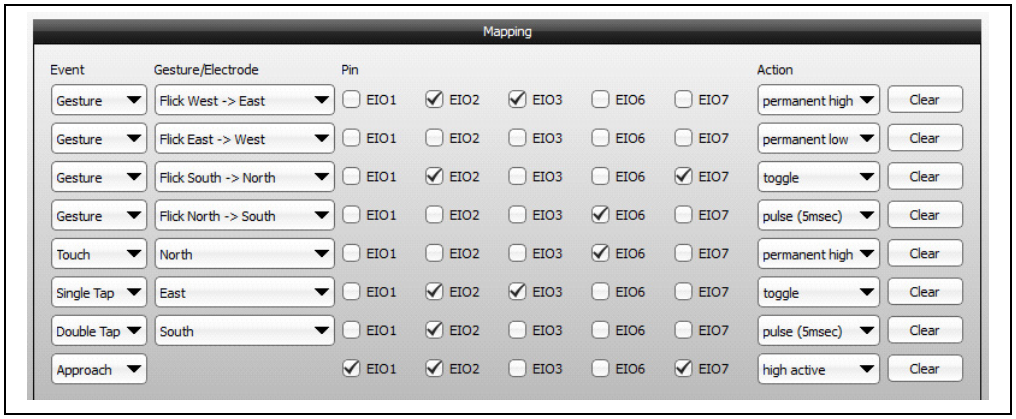
1. **Event**: The first step is to choose the event input. This event can be one of the following:
   - Gesture
   - Touch
   - Single Tap
   - Double Tap
   - Wake-up after Approach Detection
2. **Gesture/Electrode**: Depending on the selected event input, it is either possible to choose flicks or discrete circles for a gesture event. If a Touch, Single or Double Tap event is intended to trigger, it is possible to select one of the available electrodes. There is no further option for the Approach event.
3. **Pin**: Selects the EIO(s) on which will be mapped the events outputs. This setting can be any combination of EIO1, 2, 3, 6 or 7 for each event output.
4. **Action**: The Action dropdown configures the pin with a special function which will happen on the event. It is possible to set the pin permanently high or low with all events. With gestures, it is further possible to toggle the pin and to pulse it every 5 ms. In addition to the permanent high or low switch, the approach event allows a switch high or low while the approach is detected. The Touch event allows all available functions (permanent switch high/low, toggle, pulse 5 ms and switch high/low while holding the finger on the electrode) (see Figure 2-55).

FIGURE 2-55: EVENT ACTION



5. **Clear**: Resets the event back to initial value (see Figure 2-56).

FIGURE 2-56: GESTURE PORT



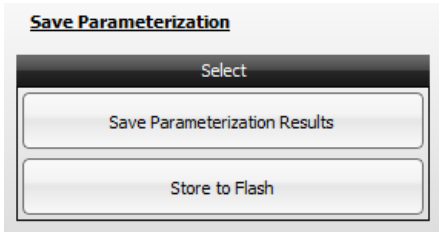
© 2013 Microchip Technology Inc.

2.3.2.15 SAVE PARAMETERIZATION

Once the Colibri Suite Parameterization is finished, the user can (see Figure 2-57):

- Save Parameterization Results
- Store to Flash

FIGURE 2-57: PARAMETERIZATION STEP – FINISHED

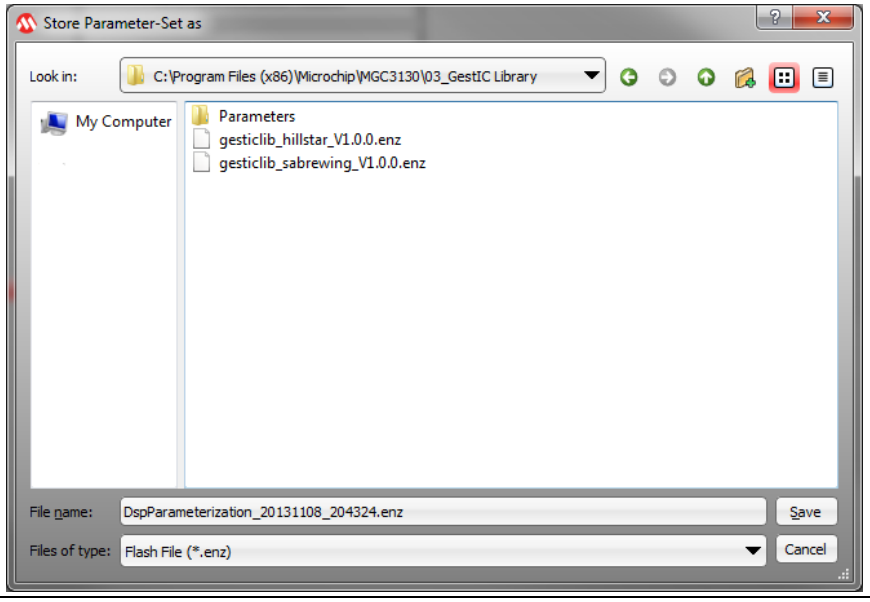


2.3.2.15.1 Save Parameterization Results

The user can store the parameterization results, as they may be needed for further fine-tuning or as a reference to parameterize another board.

Press the **Save Parameterization Results** button to save the results. The file is saved with the extension of `*.enz` (see Figure 2-58). A finished parameterization contains the parameters file and a complete GestIC Library including the saved parameters. Aurea either allows to load the `*.enz` file as a parameterization file or as a GestIC Library.

FIGURE 2-58: SAVING PARAMETERIZATION RESULTS



2.3.2.15.2 Store to Flash

The Colibri Suite Parameterization Results can be stored permanently into the MGC3130 controller Flash by clicking **Store to Flash** (see Figure 2-57).

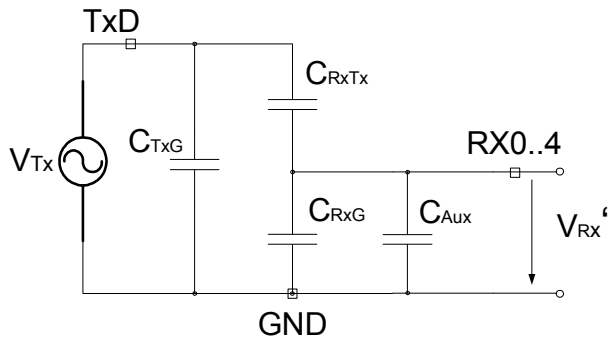
Note: In order to make a new parameterization effective in the running system one of the following steps are recommended:

- Store parameterization to Flash and reset MGC3130
- Save parameterization as an `*.enz` file and load it as GestIC® Library

2.3.3 Electrode Capacitance Measurement

The Electrode Capacitance Measurement is made to determine the capacities between Rx electrode and device ground (C_{RxG}) and the capacities between the Rx and Tx electrodes (C_{RxTx}). The measurement procedure is divided in two separate steps. First step does not need any hardware modification, while the second step needs to solder auxiliary capacitors between the five Rx electrodes and Ground (see Figure 2-59).

FIGURE 2-59: EQUIVALENT CIRCUIT WITH AUXILIARY CAPACITORS



V_{Tx}: Driven Input Voltage for Tx Signal

$V_{Rx'}$: Voltage over C_{RxG} after placing C_{Aux}

C_{TxG}: Capacitance between Tx and GND

C_{RxTx}: Capacitance between Rx and Tx

C_{RxG}: Capacitance between Rx and GND

C_{Aux}: Auxiliary Capacitance for establishing the voltage divider

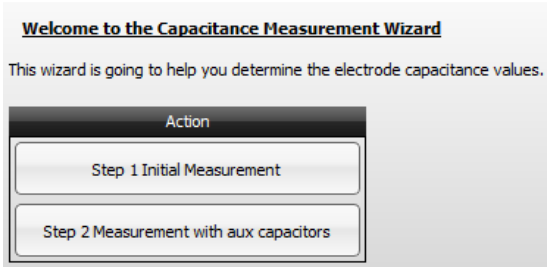
Note 1: For information about Capacitance measurement, please refer to *"MGC3130 GestIC® Design Guide"* (DS40001716).

2: The Hillstar Development kit provides an easy integration of these auxiliary capacitors. The reference electrode board provides ground connection close to the electrodes connector. The auxiliary capacitors can be soldered between the connector and ground.

When selecting the electrode capacitance measurement task, there are two possibilities: to start an initial measurement by using the **Step 1: Initial Measurement** button or to start the second step set by clicking **Step 2: Measurements with Aux Capacitors** (see Figure 2-60).

- Step 1: Start initial measurement and save results.
- Step 2: Load results from Step 1 and start measurement with auxiliary capacitors.

FIGURE 2-60: ELECTRODE CAPACITANCE MEASUREMENT – SELECTION

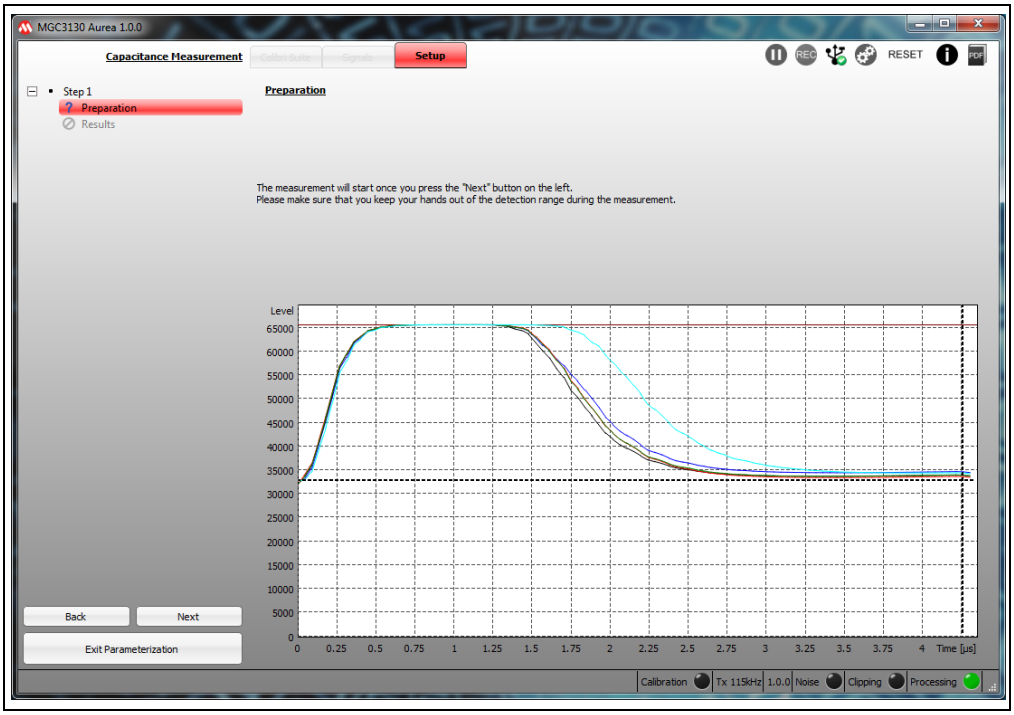

Welcome to the Capacitance Measurement Wizard
This wizard is going to help you determine the electrode capacitance values.
Action
Step 1 Initial Measurement
Step 2 Measurement with aux capacitors

© 2013 Microchip Technology Inc.

2.3.3.1 STEP 1: INITIAL MEASUREMENT (V_{Rx})

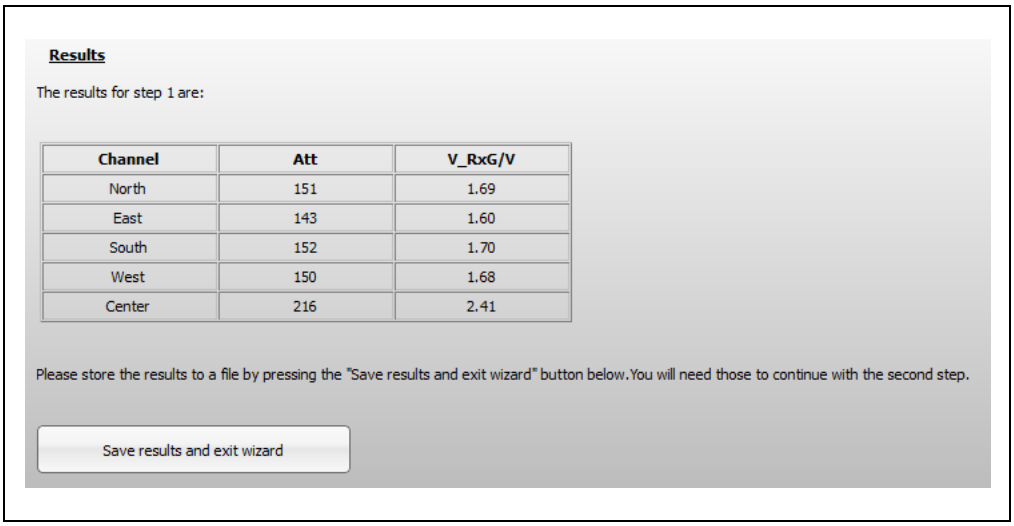
Clicking **Step 1: Initial Measurement** will start the Electrode Capacitance Measurement process at the first step and the Rx signal is shown during the first half period of the Tx transmit signal at a working frequency of 115 kHz. The Electrode Capacitance Measurement uses the level at the sampling point indicated in Figure 2-61 to calculate the V_{RxG}. The unit is digits.

FIGURE 2-61: ELECTRODE CAPACITANCE MEASUREMENT – FIRST STEP



Pressing **Next** starts the measurement and displays the results.

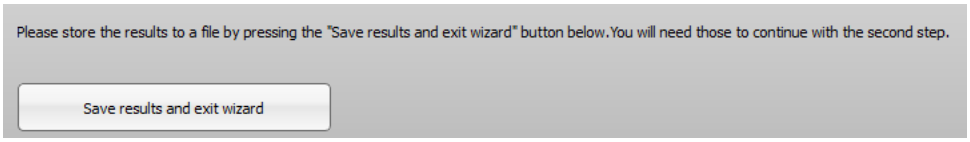
FIGURE 2-62: ELECTRODE CAPACITANCE MEASUREMENT – FIRST STEP RESULTS



The user has to save the first step results as they are needed for the second step.

Press the **Save results and exit wizard** button to save the results. The file is saved with the extension of `*.cws1` (see Figure 2-63).

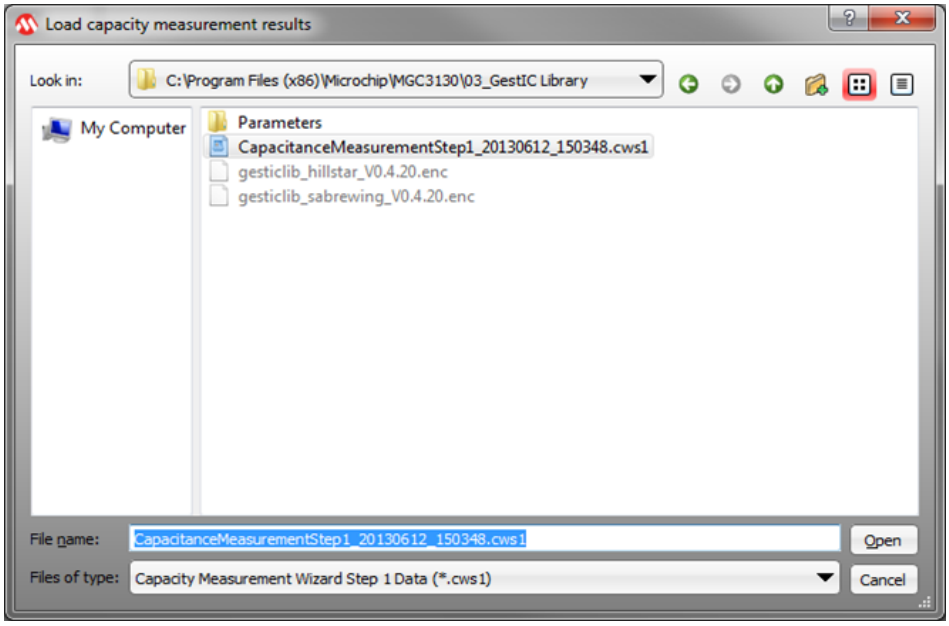
FIGURE 2-63: ELECTRODE CAPACITANCE MEASUREMENT – FIRST STEP SAVE RESULTS


Please store the results to a file by pressing the "Save results and exit wizard" button below.You will need those to continue with the second step.
Save results and exit wizard

2.3.3.2 STEP 2: MEASUREMENT WITH AUXILIARY CAPACITORS (V'_{Rx})

Pressing the **Step 2: Measurement with auxiliary capacitors** button will open the Dialogue window shown in Figure 2-64. Select the capacity measurements results file which has been saved during the first step and press **Open**. The measurement settings file always has the file ending `*.cws1` (see Figure 2-64).

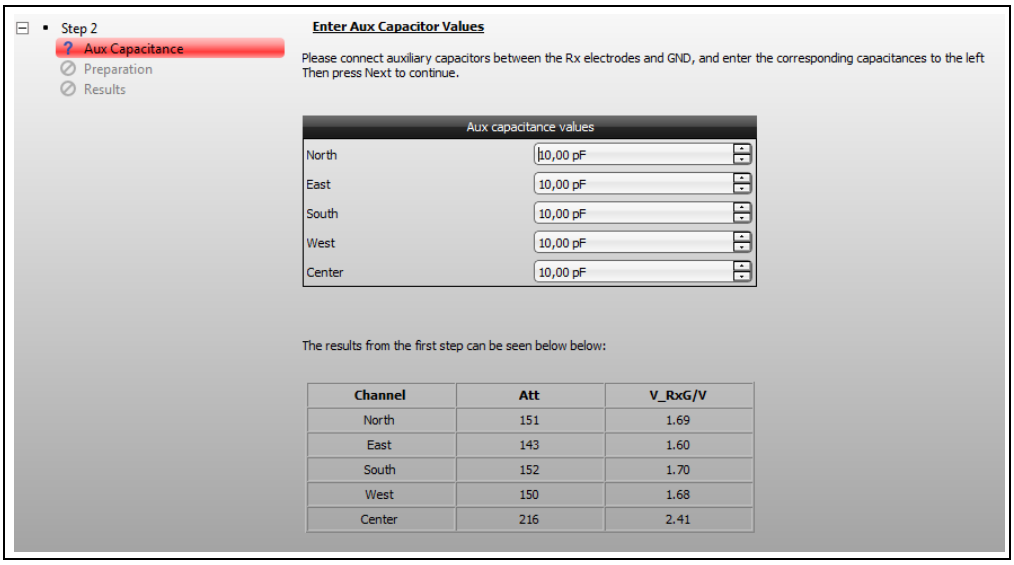
FIGURE 2-64: ELECTRODE CAPACITANCE MEASUREMENT – LOAD CAPACITY MEASUREMENT RESULTS



© 2013 Microchip Technology Inc.

The Electrode Capacitance Measurement will automatically jump to the second step where a new measurement with auxiliary capacitors will be conducted. The first step measurement results will be displayed (see Figure 2-65). The user has to enter in the five soldered auxiliary capacitors values. Refer to "*MGC3130 GestIC® Design Guide*" (DS40001716) for more details.

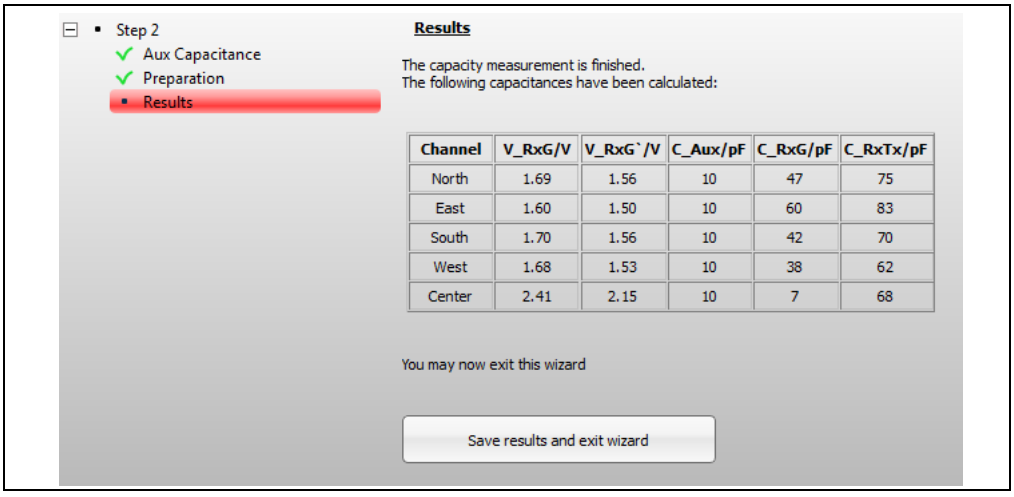
FIGURE 2-65: ELECTRODE CAPACITANCE MEASUREMENT – CAPACITY MEASUREMENTS WITH AUXILIARY CAPACITORS


Step 2
Aux Capacitance
Preparation
Results
Enter Aux Capacitor Values
Please connect auxiliary capacitors between the Rx electrodes and GND, and enter the corresponding capacitances to the left
Then press Next to continue.
Aux capacitance values
North 10,00 pF
East 10,00 pF
South 10,00 pF
West 10,00 pF
Center 10,00 pF
The results from the first step can be seen below below:
Channel Att V_RxG/V
North 151 1.69
East 143 1.60
South 152 1.70
West 150 1.68
Center 216 2.41

Pressing **Next** will show the Rx signal. The signal plot is generated by sweeping the sampling time, relative to the time instance when the Tx potential is switched to its high level. Electrode Capacitance Measurement uses the level at the sampling point indicated in Figure 2-61 to calculate the V'_{RxG}. The Rx signal is generated at a working frequency of 115 kHz. The unit is digits.

Pressing **Next** again will start the measurement and display the capacitance results between the Rx electrode and GND (C_{RxG}) and the capacitance between the Rx and Tx electrodes (C_{RxTx}) as shown in Figure 2-66.

FIGURE 2-66: ELECTRODE CAPACITANCE MEASUREMENT – CAPACITY MEASUREMENTS WITH AUXILIARY CAPACITORS RESULTS


Step 2
Aux Capacitance
Preparation
Results
Results
The capacity measurement is finished.
The following capacitances have been calculated:
Channel V_RxG/V V_RxG`/V C_Aux/pF C_RxG/pF C_RxTx/pF
North 1.69 1.56 10 47 75
East 1.60 1.50 10 60 83
South 1.70 1.56 10 42 70
West 1.68 1.53 10 38 62
Center 2.41 2.15 10 7 68
You may now exit this wizard
Save results and exit wizard

Press the **Save results and exit wizard** button to save the results. The file is saved with the extension of `*.cws1`.

Chapter 3. Advanced Aurea Features

3.1 LOGGING SENSOR DATA

It is possible to log and store the data streamed from the MGC3130 controller to the PC. This can be used for observing data over long time periods and for system debugging. The log file contains:

- Message: All messages sent from the MGC3130 in hex format.
- Data: System Status information and Sensor Data of the Colibri Suite decoded from the respective messages. The data fields contain:
  - Operation mode
  - Working frequency
  - XYZ position
  - Uncalibrated Sensor Data
  - Signal deviation
  - Touch
  - Tap
  - Double Tap
  - AirWheel
  - Gestures

Note: The kind of messages being logged depends on the active Aurea tab and the content displayed inside (refer to **Section 3.1.2 "Log File Content and Format "**).

3.1.1 Record a Log File

To start logging data:

1. Press the **REC** button in the upper right corner of Aurea. Aurea immediately starts logging data in the background. The logged data includes a 30-second history.
2. In the dialog box confirm the file name and press **OK**.
3. Press **REC** again to stop the logging process.

3.1.2 Log File Content and Format

The log file is a text file containing consecutive messages separated by line feeds. Individual data fields are tab separated. The kind of data being logged depends on the active Aurea tab, and the content displayed inside. If there are data which are not logged, the respective data fields are kept empty. An example of the log file is shown in Figure 3-1.

FIGURE 3-1: LOG FILE

GestIC Library: HillstarV01 1.0.0 ID9000r1849
GestIC CDC Bridge: 2.21

TIME (s)	DATA MESSAGE	Running	fTx Byte 1	Pos x Byte 2	Pos y ...	Pos z	CIC S	CIC W	CIC N	CIC E	CIC C	SD S	SD W	SD N	SD E	SD C	Touch	Tap	DblTap	AirWheel	Gesture
0.008	MESSAGE		34	08	4A	91	20	19	2E	8C	34	07	EA	3B	C1	FF	C8	43	FC		
			0C	4F	44	82	B7	AC	44	24	49	6C	44	43	02	AF	44	E0	12		
			9E	BD	9B	51	83	3F	09	D7	D2	BF	AE	4F	4F	40	EC	CF	5E		
			40																		
0.008	DATA	1	103	65534	0	60565	33170.0	33596.2	34149.7	33713.1	34168.1	-0.1	1.0	-1.6	3.2	3.5	0	0	0	-	-
1.967	MESSAGE		3A	08	CE	91	23	19	B2	8C	08	67	02	10	04	40	B0	B8	05		
			3D	C1	FA	CC	43	3A	60	4E	44	E1	23	AD	44	89	2B	6D	44		
			B8	2A	AF	44	00	00	00	00	00	00	00	00	00	00	00	00	00		
			00	00	00	00	00	00	00												
1.968	DATA	1	103	63391	40665	65535	33178.0	33593.5	34153.1	33716.7	34169.3	0.0	0.0	0.0	0.0	0.0	0	0	0	-	Flick West -> East
3.996	MESSAGE		38	08	66	91	22	19	4A	8C	04	10	00	40	7D	04	6B	3C	60		
			EF	D1	43	CB	B0	50	44	DA	68	AE	44	DD	4A	6F	44	53	2E		
			B1	44	78	60	B9	C0	00	50	D6	BC	70	E0	1B	40	00	65	74		
			BE	40	D4	C2	BF														
3.998	DATA	1	103	0	65535	65535	33187.9	33602.8	34163.3	33725.2	34185.4	-5.8	-0.0	2.4	-0.2	-1.5	0	0	0	-	Flick South -> North
12.918	MESSAGE		3A	08	62	91	30	19	46	8D	DA	B5	30	BA	0B	13	10	95			
			96	3D	8F	E8	5D	44	3F	12	7E	44	A5	0D	D1	44	74	34			
			BC	44	19	C3	54	45	9D	0B	F0	43	02	57	3D	43	14	96			
			93	43	E3	C0	13	44	9F	AB	05	45									
12.919	DATA	1	103	46554	47664	4875	33655.6	33784.3	34440.4	34273.6	36172.2	480.1	189.3	295.2	591.0	2138.7	10	0	0	0	-
20.314	MESSAGE		3C	08	27	91	38	19	0B	8F	BC	00	EF	1C	56	89	2E	99			
			1B	49	48	3F	05	2A	14	44	D0	CF	61	44	72	30	B2	44			
			80	63	7B	44	50	43	BC	44	47	BD	1D	43	0D	65	CE	42			
			DE	64	84	42	CA	8B	2A	42	F2	C3	0B	43							
20.314	DATA	1	103	7407	35158	39214	33360.7	33671.2	34193.5	33773.6	34274.1	157.7	103.2	66.2	42.6	139.8	0	0	0	bc	-
28.114	MESSAGE		38	08	3F	91	22	19	20	8C	07	20	00	40	6C	7E	B5	3B			
			A4	83	CB	43	F4	16	50	44	0F	03	AC	44	0A	1B	6C	44			
			2D	22	AF	44	74	52	AB	40	CA	75	15	41	68	B1	64	3F			
			7B	CC	9C	40	06	6D	4D	40											
28.116	DATA	1	103	23332	44113	65535	33175.0	33600.4	34144.1	33712.4	34169.1	5.4	9.3	0.9	4.9	3.2	0	0	0	0	Circle counterclockwise

Table 3-1 explains the data fields of the decoded messages.

TABLE 3-1: DATA

Data Field	Description
Running	Indicates if DSP operating mode is running. Possible values: 1 = Running 0 = MGC is going into Self Wake-up mode
fTx	Tx working frequency in kHz Range: (44..115)
Position	Positions are logged any time the GestIC® Library detects a valid position. The data give the position of the user's hand in the Cartesian coordinate system. Position data of [0,0,0] represent the origin of the coordinate system, and data of [65535, 65535, 65535] are the maximum dimension of the sensing space. For coordinate system orientation and origin, refer to **Section 2.1.1 "Colibri Suite Tab"**. Pos x: Range: (0..65535) Pos y: Range: (0..65535) Pos z: Range: (0..65535)
Uncalibrated Signal	The Uncalibrated Signal (CIC) is logged when Uncalibrated Signal or Noise Level is selected in the **Signals** tab. CIC S (South): Range: (-3.402823e+38..3.402823e+38) CIC W (West): Range: (-3.402823e+38..3.402823e+38) CIC N (North): Range: (-3.402823e+38..3.402823e+38) CIC E (East): Range: (-3.402823e+38..3.402823e+38) CIC C (Center): Range: (-3.402823e+38..3.402823e+38)
Signal Deviation	Signal Deviation (SD) is logged when Signal Deviation or Signal Deviation Mean is selected in the **Signals** tab or when **Colibri Suite** tab is active. SD S (South): Range: (-3.402823e+38..3.402823e+38) SD W (West): Range: (-3.402823e+38..3.402823e+38) SD N (North): Range: (-3.402823e+38..3.402823e+38) SD E (East): Range: (-3.402823e+38..3.402823e+38) SD C (Center): Range: (-3.402823e+38..3.402823e+38)
Touch	Touch is logged any time a touch is recognized. Bit 0: Touch South electrode Bit 1: Touch West electrode Bit 2: Touch North electrode Bit 3: Touch East electrode Bit 4: Touch Center electrode
Tap	Tap is logged any time a Tap is recognized. Bit 0: Tap South electrode Bit 1: Tap West electrode Bit 2: Tap North electrode Bit 3: Tap East electrode Bit 4: Tap Center electrode
Double tap	Double Tap is logged any time a Double Tap is recognized. Bit 0: Double Tap South electrode Bit 1: Double Tap West electrode Bit 2: Double Tap North electrode Bit 3: Double Tap East electrode Bit 4: Double Tap Center electrode
AirWheel	AirWheel is logged any time an AirWheel is recognized. The counter value, which indicates how far the AirWheel rotation has progressed, is logged.
Gesture	Gestures are logged any time a gesture is recognized. Gesture info is given in plain text.

© 2013 Microchip Technology Inc.

3.2 SENSITIVITY PROFILE ACQUISITION

The sensitivity profile gives information about the system performance and, thus, is essential when benchmarking individual GestIC systems. It is defined as signal deviation measured over positions and acquired by moving a defined measuring object (hand brick) over the sensitive area from one side to the other.

While recording sensitivity profiles, the MGC3130 controller must run in Processing mode with a fixed Tx working frequency (e.g., 103 kHz). Autocalibration must be deactivated. The following steps set up the GestIC system for sensitivity profile acquisition:

1. Connect the GestIC device to your PC via USB and open Aurea.exe.
2. Activate the **Signals** tab and display Control by clicking on the upper left arrow.
3. Turn off Autocalibration. Deactivating Autocalibration also disables the Approach Detection feature. The controller is constantly running in Processing mode.
4. Set Tx working frequency to 103 kHz.
5. Select the Signal Deviation Mean signals from the drop-down list.

You can now start recording the sensitivity profile.

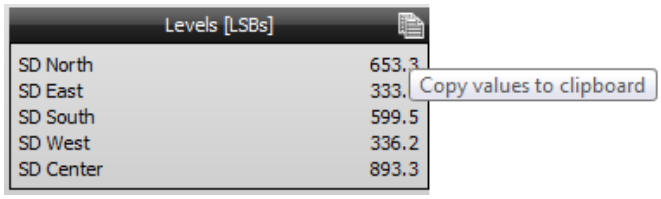
3.2.1 Sensor Calibration

Use the **Force Calibration** button for manually calibrating the system when there is no approach to the system (measuring object is not within the sensing space).

3.2.2 Measurement

1. Place the brick in the defined start position (e.g., hand brick at 3 cm height over the center of the East electrode).
2. Read the Signal Deviation values and move the brick to the next position (e.g., 1 cm toward West).
3. Continue until the brick is at the end position (West electrode). In order to record data at each of the above steps, press **Freeze** to halt the signal stream. Transfer the Signal Deviation Mean values to another application by marking and copying them through the clipboard (see Figure 3-2).

FIGURE 3-2: TRANSFER SIGNAL VALUES



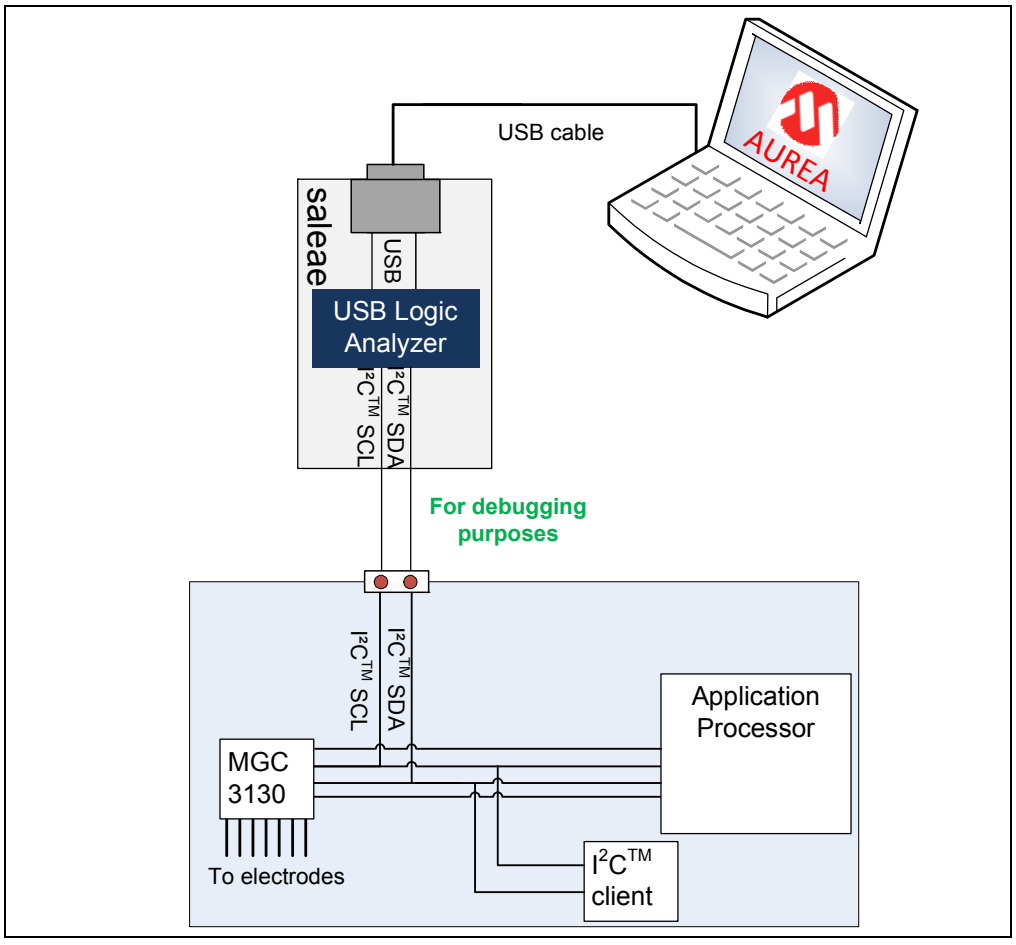
Note: Due to the applied filter, the Signal Deviation Mean signals show a delay of 10 seconds. Make sure the signals are settled before using them.

3.3 SNIFFING MODE

Using a ***Saleae USB Logic Analyzer (8- or 16-channel)***, Aurea GUI is also able to spy a GestIC Library I²C communication and displays the data streamed from the MGC3130 controller. This can be used for observing data for system debugging. Aurea uses the streamed data for:

- XY Position Tracking plot (2D)
- XYZ Position Tracking plot (3D)
- Signal Level bar graph
- Gesture Indication
- Uncalibrated Signal plot
- Signal Deviation plot
- Signal Deviation Mean plot
- Noise Level plot

FIGURE 3-3: AUREA AND SALEAE INTERFACE



Note 1: Aurea can only read data enabled by the application processor. The Sniffing mode does not provide functions to control MGC3130.

2: In Sniffing mode, Signal Deviation Mean (SDM) and Noise Level (NL) measurements may stop before they are finished if the Approach mode is activated on the MGC3130. Host application may adjust the Idle Time-out or deactivate the Approach Detection feature.

© 2013 Microchip Technology Inc.

3.3.1 Saleae

Saleae USB Logic analyzer is a logic analyzer used to record, view, and measure digital signals. In addition, Saleae currently has 17 different protocol analyzers including serial, I^2C, SPI, CAN and many more. Saleae can sample each of its 8 channels at up to 24 MHz and can record up to 10 billion samples.

3.3.2 Install Saleae

To install Saleae on your system:

- Download and install the Saleae software package from http://www.saleae.com

3.3.3 Saleae Hardware Connection

To use Saleae as I^2C spy logic, two channels and the ground should be connected to the GestIC I^2C bus (see Table 3-2).

TABLE 3-2: SALEAE HARWARE CONNECTION

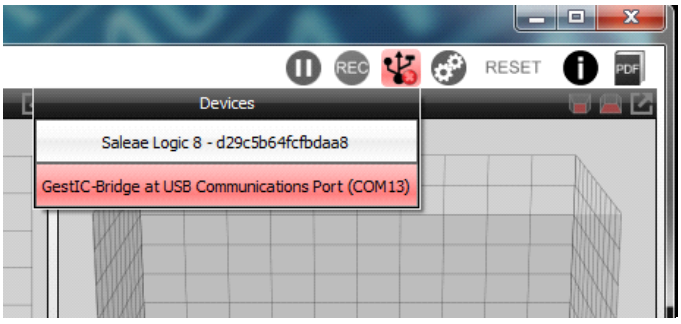
MGC3130 Pin	Saleae Channel
SI0 (I2C0 SDA)	Channel 0..7 for 8-Channel Channel 0..15 for 16-Channel
SI1 (I2C0 SCL)	Channel 0..7 for 8-Channel Channel 0..15 for 16-Channel
GND	GND

3.3.4 Running Aurea with Saleae

To run Aurea using Saleae Logic Analyzer please proceed as follows:

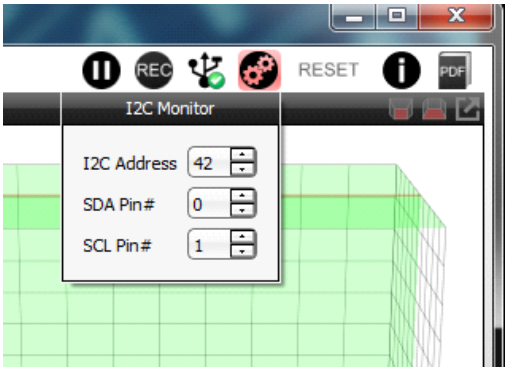
1. Connect the Saleae Logic Analyzer hardware to the respective pins on the MGC3130 GestIC application hardware.
2. Connect and power the main GestIC hardware application.
3. Connect Saleae to the PC via USB.
4. Run Aurea.
5. Press the **Disconnect GestIC HW** button in the upper right corner of Aurea. Press again the same button and Aurea will immediately show the available hardware which can be used to collect the MGC3130 streamed data. An example is illustrated in Figure 3-4.

FIGURE 3-4: AUREA DEVICES



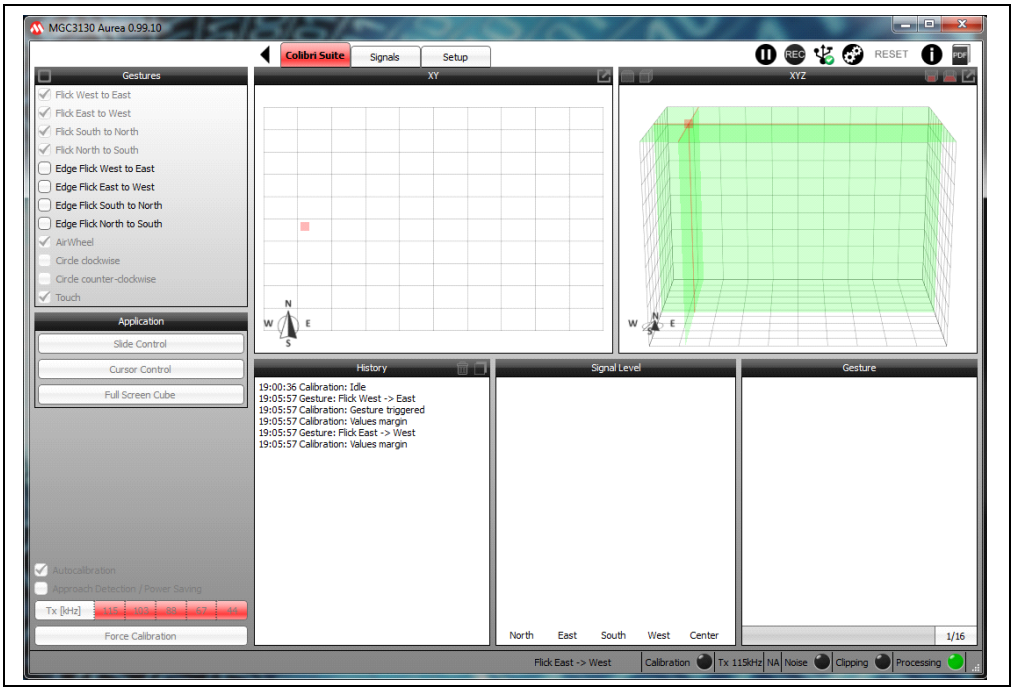
6. Select Saleae Logic 8.
7. To configure the Saleae hardware mapping, press the **Preferences** button in the upper right corner of Aurea. The I²C Monitor configuration list will be displayed containing (see Figure 3-5):
   a) I²C Address: selects the MGC3130 I²C. The value is in hexadecimal and can be `0x42` or `0x43`.
   b) SDA Pin#: selects which Saleae Logic Analyzer channels is mapped to I²C SDA pin of MGC3130
   c) SCA Pin#: selects which Saleae Logic Analyzer channels is mapped to I²C SCL pin of MGC3130

FIGURE 3-5:AUREA RUNNING ON SALEAE



8. Aurea will display the data collected over the I²C bus.

FIGURE 3-6: AUREA RUNNING ON SALEAE



© 2013 Microchip Technology Inc.

Appendix A. Glossary

TABLE A-1: GLOSSARY

Term	Definition
AFE	Analog Front End
Application Host	PC or embedded controller which controls the MGC3130
Aurea	MGC3130 PC control software with graphical user interface
Colibri Suite	Embedded Digital Signal Processing (DSP) suite within the GestIC® Library
Deep Sleep	MGC3130 Power-Saving mode
E-field	Electrical field
Frame Electrodes	Rectangular set of four electrodes for E-field sensing
GestIC® Technology	Microchip's patented technology providing 3D free-space gesture recognition utilizing the principles of electrical near-field sensing
GestIC® Library	Includes the implementation of MGC3130 features and is delivered as a binary file preprogrammed on the MGC3130
Gesture Recognition	Microchip's stochastic HMM classifier to automatically detect and classify hand movement patterns
Gesture Set	A set of provided hand movement patterns
Hand Brick	Copper coated test block (40x40x70 mm)
HMM	Hidden Markov Model
MGC3130	Single-Zone 3D Gesture Sensing Controller
Position Tracking	GestIC® technology feature
Sabrewing	MGC3130 evaluation board
Self Wake-Up	MGC3130 Power-Saving mode
Sensing Area	Area enclosed by the four frame electrodes
Sensing Space	Space above Sensing Area
Signal Deviation	Term for the delta of the sensor signal on approach of the hand versus non-approach
Spacer Brick	Spacer between the sensor layer and hand brick (Styrofoam block 40x40xh mm with h= 1/2/3/5/8/12 cm)
SPU	Signal Processing Unit
Approach Detection	GestIC® technology feature: Power-Saving mode of the MGC3130 with approach detection
Hillstar – MGC3130 Development Kit	Hillstar Development Kit supports an easy integration of Microchip's MGC3130 3D Tracking and Gesture Controller into customer's applications

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://www.microchip.com/support
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX
Tel: 512-257-3370

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Cleveland
Independence, OH
Tel: 216-447-0464
Fax: 216-447-0643

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Novi, MI
Tel: 248-848-4000

Houston, TX
Tel: 281-894-5983

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

New York, NY
Tel: 631-435-6000

San Jose, CA
Tel: 408-735-9110

Canada - Toronto
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8569-7000
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Chongqing
Tel: 86-23-8980-9588
Fax: 86-23-8980-9500

China - Hangzhou
Tel: 86-571-2819-3187
Fax: 86-571-2819-3189

China - Hong Kong SAR
Tel: 852-2943-5100
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8864-2200
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4123

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-3019-1500

Japan - Osaka
Tel: 81-6-6152-7160
Fax: 81-6-6152-9310

Japan - Tokyo
Tel: 81-3-6880- 3770
Fax: 81-3-6880-3771

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-5778-366
Fax: 886-3-5770-955

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Dusseldorf
Tel: 49-2129-3766400

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Pforzheim
Tel: 49-7231-424750

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Venice
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Poland - Warsaw
Tel: 48-22-3325737

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820

10/28/13

© 2013 Microchip Technology Inc.